

November 19, 1962

SPECIAL REPORT:

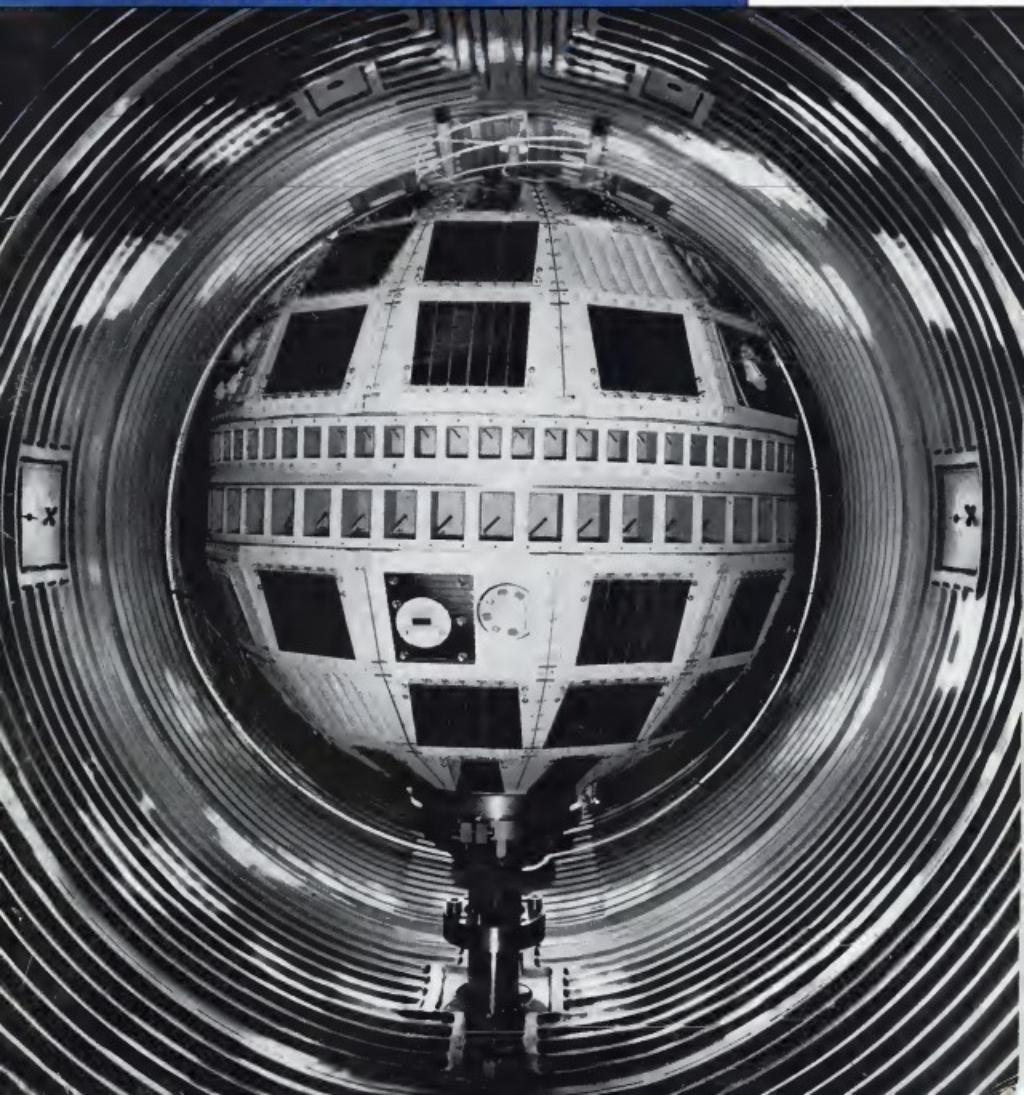
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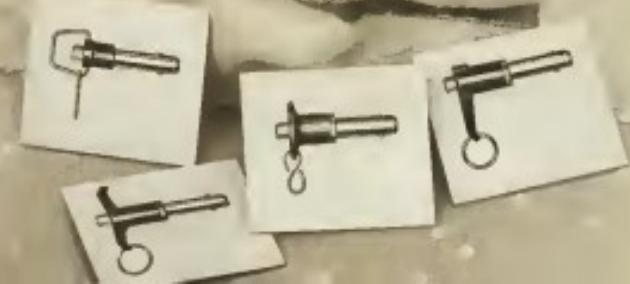
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Journal of Polymer Science: Part A: Polymer Chemistry, Vol. 37, 293-298 (1999)
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POINT REYES STATION, CALIFORNIA

AEROSPACE CALENDAR

- Nov. 26-27—Western States Society Meeting, The Coeur d'Alene Institute, Coeur d'Alene, Idaho.

Nov. 26-28—Annual Coordinated Manufacturing and Assembly Society, Acme Manufacturing Building, 1801 Sherman Hotel, Wichita, Kansas.

Nov. 27-28—Mid-Northeast American Defense Plants and Manufacturers Assn., The Keeler, Bronx Beach, New York.

Nov. 27-28—Flight Meeting, Radio Technical Committee, Hotel Americana, Manhattan Motor Hotel, Washington, D. C.

Nov. 28-30—1963 University Symposium on Institute of Radio Engineers, Columbia University, New York, N. Y.

Dec. 4-18th Annual International Air Shows, Seattle, Flight Safety Foundation, Seattle, Washington, WA (HFB members by invitation).

Dec. 4-6—Fall Joint Computer Conference, Stevens Hotel, Philadelphia, Pa. Sponsored by American Federation of Information Processing Societies, ERIC.

Dec. 11-13—1963 Convention, National Aviation Association, Hotel Statler, Los Angeles, Calif., Las Vegas, Nev.

Dec. 12-13—Annual National Air Law Conference, Flamingo Hotel, Las Vegas, Nev.

Dec. 13-14—Annual Disney Meeting, Disneyland, Anaheim, Calif. (HFB members), Los Angeles, Calif. Special Guests: Mr. E. Bradley, Jr.

Dec. 14-15—Western Communications Conference, Coeur d'Alene Inn, Coeur d'Alene, Idaho.

McGraw-Hill Ryerson

and others 2000; and others, forthcoming).

December 29, 1942

and the other two were the same as the first, but the last was
of a different color.

Information about correspondence and changes of address: Please send address changes to the American Mathematical Society, 201 Charles Street, Providence, Rhode Island 02904-2294; or to the editor, Department of Mathematics, University of California at Berkeley, Berkeley, California 94720.



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AEROSPACE CALENDAR

(Continued from page 7)

May 11-12—Aerospace Flight Testing Conference, National Aeronautic Society and Institute of the Aerospace Sciences, Cocoa Beach, Fla.
May 19-21-1961 Western Manufacturing and Congress, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles.

May 20-21—Second Air Force sponsored Seminar on Sensors, Dobbins Air Force Base, Georgia.

May 25-26—Instrumentation Conference, Institute of Radio Engineers, Wadsworth Annex and Coliseum New York, N.Y.

May 30-June 1—Annual Structures and Materials Conference, American Society of Mechanical Engineers, El Mendo Hotel, Palo Alto.

Aug. 14-Eighth Annual Business Aircraft Safety Seminar, Flight Safety Foundation, Greenwich Plaza New York, N.Y.

Aug. 21-Annual Conference, Applied Operational Research, Marquette Hotel, Washington, D.C.

Aug. 30-41—Fourth Symposium on Engineering Aspects of Magnetohydrodynamics, University of California, Berkeley.

Aug. 31-Sept. 1—Hydrogen Rocket Conference, American Rocket Engineers and American Society of Mechanical Engineers, Naval Ordnance Laboratory, White Oak, Md.

Aug. 31-September 1—Ninth Nuclear Magnetic Resonance Seminar, Sheraton Hotel, Washington, D.C., sponsored by American Institute of Electrical Engineers, IEEE.

Aug. 15-18—Instrumentation Conference and Electronic Show, Institute of Radio Engineers, Dallas Memorial Auditorium, Dallas, Tex.

Aug. 21-Technological Meeting, Nuclear Magnetic Resonance Applications, American Nuclear Society, Netherlands Hilton Hotel, Columbus, Ohio.

Aug. 22-23—Annual Meeting, National Astronautical Services Association, Washington, D.C.

Sept. 2—Biosciences Conference, American Radiar Society and Acoustics Medical Assn., Los Angeles, Calif.

Sept. 3-6—Fourth National Symposium on Human Factors in Electronics, Institute of Radio Engineers, Washington, D.C.

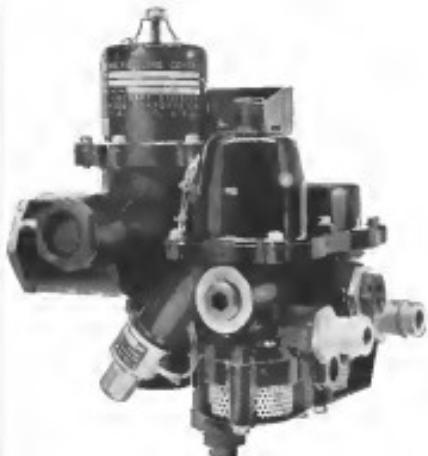
May 24—Electronics Components Conference, Institute of Radio Engineers, Massachusetts Technical School, Boston.

May 25-26—National Symposium on Navigation Theory and Techniques, Institute of Radio Engineers, Monrovia Hotel, Santa Monica, Calif.

May 28-29—Instrumentation Conference, Institute of Radio Engineers, Phoenix Hotel, Albuquerque, N.M.

May 31-June 1—National Telecommunications Conference, American Federation of Information Processing Societies, Caltech Hotel, Pasadena, Calif.

June 6-9—French International Air Show, Le Bourget, Paris, France.



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This was the beginning of one of the longest and most successful relationships between a prime and a subcontractor in the aerospace industry.

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Avco's long association with the C-130 project extends to an expertise and skill in the field of lightweight, high-strength structures. Other important projects in which it is working include upper aft fuselage section for the B-57 bomber produced by North American Aviation, Inc., components for NASA's Saturn booster, F-108-25 height-finder radar reflectors for Avco's Electronics Division.

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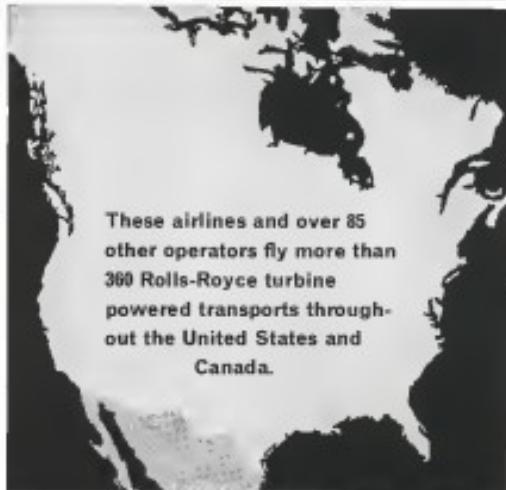
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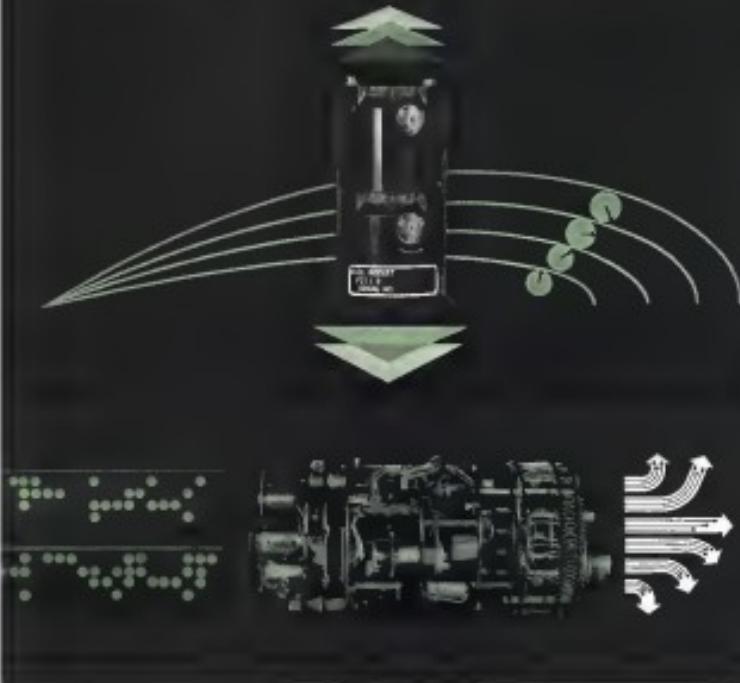
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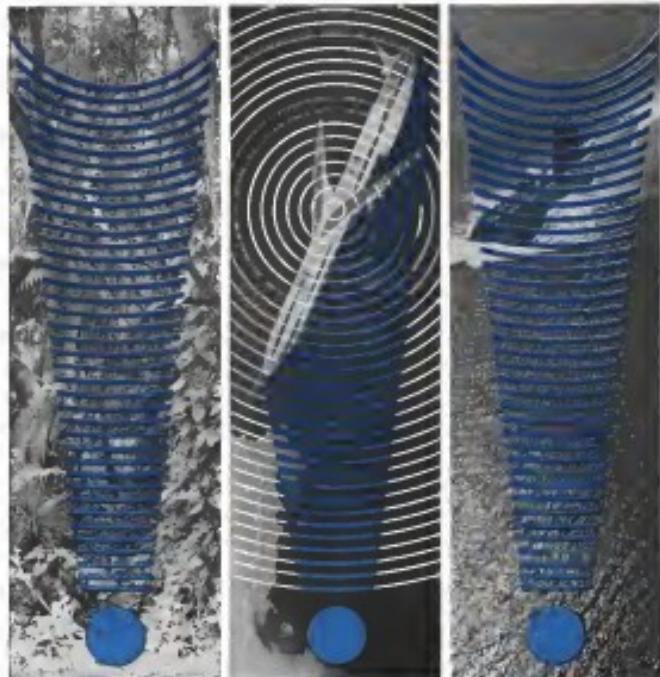
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EDITORIAL

NASA Growing Pains

The National Aeronautics and Space Administration shows signs of suffering from acute growing pains in the fiscal 1964 budgeting season begun. There are solid indications that the Apollo manned lunar landing program is already beginning to slow due to financial strain (AW Nov. 12, p. 27), and further significant savings may be expected unless its funding is increased. Already, other aspects of NASA's rightly lauded space exploration program are being pruned to provide funds for the Apollo program, and the strains in these areas will grow worse if present funding plans don't change.

It is not unusual that an organization that has grown as fast as NASA during the past five years should be suffering from growing pains and budgetary. Almost from its inception, NASA has shown a trend toward constantly underestimating the cost requirements of its major technical programs. For example, the cost of the Mercury research orbital space flight program had quadrupled over the original cost estimates made by NASA. One major phase of Mercury schools cost 10 times the original price tag. The Apollo program and many other key NASA systems are already showing signs of doubling the original estimate of using costs. This is naturally disturbing to the program managers who are charged with pushing on toward their technical goals at full speed, to the NASA administration which sensed Congress did their funding budget scope was sufficient to achieve desired goals within minimum time spans, and to the congressmen who have supported NASA programs and budgets because of the assurance that they met the high priority goals established by President Kennedy some 18 months ago. But it is really as inevitable as the product of any major effort to push hard along a major technical frontier and gain some new knowledge.

Funding Needs Misunderstood

It is also one of the tragedies of our time that the vital financing requirements of major research and development efforts are as poorly addressed by the fiscal officers who control the budgeting process. As a result, we have wasted far more money in the wasteful funding techniques used to support research and development than we have through the using costs of these programs as they reach the payoff stage. These short-sighted policies, based on short-term financing strategies, have developed far more drag on the long-term goals of research progress than any technical obstacle. They have been particularly acute in the development of new military weapon systems during the past decade and they now threaten to develop the same bureaucratic bottleneck on the national space program.

When a nation sets its technical sights as far out as we have in our entire space technology program and particularly in the planned lunar landing program, it is impossible to estimate accurately the eventual cost of this effort at its inception. No blame should attach to anyone or any agency for the failure to do so, although

it won't be long before the General Accounting Office and the Reorganization Board, with their 20-20 hindsight, will begin to critique solutions on this issue.

The real problem presented by the growing pains of the space agency as it approaches its fiscal 1964 budget process is whether it is going to stick to the balanced performance goals and timetable it set for the Apollo program and other key space exploration efforts and ask for the resources necessary to do the job, or whether it is going to begin the pattern of taking its technical goals to fit a budget ceiling. There is no doubt that if President Kennedy is still around about "hosting the nation into pre-eminence in space technology, and beating the Soviets to the moon in the first tangible proof of this leadership, there will be rising resource requirements in the Apollo program program. It is also equally clear that if funding limitations are to be imposed below the rate that maximum technical progress requires, there can be little hope of achieving that leadership.

Space Program Definition

The real essence of the debate that is certain to ensue over NASA's fiscal 1964 budget level is what kind of a space program the nation really wants. Does it want a maximum effort to beat the Soviets to a manned lunar landing and establish U.S. leadership in space technology and not willing to pay a well managed effort toward this goal? Or does it want a more moderately paced effort, geared to budget ceilings rather than technical progress, and is it willing to sacrifice the chance to achieve international leadership to gain at least the illusion of financial stability, and reduce bookings?

We think that the Kennedy Administration, the Congress and the American people will have to make that decision when they handle the fiscal 1964 budget for NASA. In making that choice it is important that all of the facts involved are developed in the debate that lies ahead. It will serve an useful national purpose to try to conceal the fiscal realities of a strong space program that can push forward as fast as its technical progress allows. And it will serve an useful purpose for NASA officials to make another statement that they are getting all the money that can be "reasonably spent" when the technical people at the working levels are being decimated by fiscal beltway.

After the manner in which the news of the Cuban missile crisis was crudely controlled to produce a salaried political effect, all agencies of the government necessarily must be suspect of managing the news to suit their current purposes. Industry, Congress and the American people should be particularly alert to the unfolding of the national space policy debate, and expand cuts effort to ensure that the issues are carefully presented and the alternatives clearly outlined so that an intelligent decision can be made.

-Robert Hets

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Since the guidance system must be maintained throughout, the gyro requires a torsional vibration damper. Its theorist Company, manufacturer of both the missiles and their gyroes, uses Union Carbide's Silicone Fluid L-45. This unique feature of this fluid between the gyro's radial and external case prevents excessive resonance at frequencies near the gyro's natural resonant frequency. In this way, the gyro's response characteristics are shaped as desired in the frequency range of interest without affecting static response. And, since L-45 maintains its



Target the Rockwell missile to a pinpoint with Union Carbide's Silicone Fluids. Liquid silicone fluid dampens undesirable influences of vibration and temperature.

viscosity over a broad temperature range, it functions with dependable uniformity.

FITTING YOUR NEEDS

This silicone viscosity-temperature chart illustrates the L-45 as a primary mission fluid for usefulness as a torsional vibration damper in these examples. For example, it provides these properties:

Coefficient of thermal expansion

5.7 $\times 10^{-5}$ in/in/ $^{\circ}$ F

Viscosity Temperature Coefficient α at 50°

$$(5 - \frac{50.0}{50.0})^{1/2}$$

In addition, it has a flash point over 600°F and a pour point below -55°F. But this is only one application for silicone fluids. And Union Carbide is capable of applying formulations that will meet any specifications you set. Anywhere these materials will work. Your company's representative or our own representatives may, just as service as those involved in missile guidance, if you do well to talk to Union Carbide.



Precise equipment of every kind plays a vital role in missile vehicles. A silicones damping silicone fluid that meets all industry standards — MPT

THE KEY: PRECISE FORMULATION

The L-45 series of silicone fluids is capable in a wide range of viscosities. Heat exchange devices, electrical systems, hydraulic systems, liquid springs, and other mechanisms are utilizing silicone fluids that are precisely engineered to the task. In their formulation and production, Union Carbide maintains a rigid quality control program to provide the uniform performance properties on which you can depend.

SEE YOUR SILICONES MAN

With its growing background in silicone technology, Union Carbide is constantly advancing our lead through its three versatile materials. Your Union Carbide Silicones Man, supported by extensive resources of technical engineers, is an authority in his field. Get in touch with him to learn what is being done in silicones today. Or, for further information, send us the coupon below.



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Long Island City 1, N. Y.

In Canada: Union Carbide Canada Ltd.,
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Please send me data on silicone fluid L-45.

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Washington Roundup

Science News Confusion

Confusion over the status of scientific findings concerning the radiation belt excited by a nuclear test last July 9 continues. Dr. James E. Werner, who wrote four long-standing that of presidential science advisor, has "recommended" that the National Academy of Sciences and Science Advisory Committee no longer hold up its report on the interpretation of the data until the issue is made clearer.

Following the recommended bureaucratic procedure, NASA is categorizing the "recommendation" as an order. Both the Werner's office and NASA deny that Werner expects to slow down the work dissemination of scientific findings that NASA has worked for four years to achieve. Some NASA scientists had suspected Werner's action on a general attitude against quick release of such data.

Some information on the radiation belt was first made public in a scientific journal by two of NASA's Goddard Space Flight Center scientists, some time after a closed meeting between NASA and Defense Dept. was held to discuss the belt.

Dr. James A. Van Allen, whose theory predicted first detected the belt and who has experiments aboard Explorer 14 and 15, which as exploring it, apparently agrees with Werner that information should be machine before it is released. But he charges that it still too early to release findings from the two new Explorers. Although NASA has been precluded by its interpretation of Werner's "recommendation," from releasing any thing on the belt since Oct. 11, Van Allen received last week that the orbiter and lifetime of the belt will now be anticipated until August (see p. 28).

First flight of the USAF-North American B-70 has been delayed from December until next March or April by leaking fuel tanks. The leakage problem is related to the changing temperatures that the Mach 3 bomber will experience. Results of studies by Air Force and by the Joint Chiefs of Staff on the B-70 and its HS-38 reconnaissance strike version have not yet been disclosed by the Defense Dept.

Program of the British-French supersonic transport program (see p. 48) has prompted Federal Aviation Agency Administrator N. E. Hahn to try to accelerate U.S. supersonic transport plans. Hahn will present recommendations to President Nixon within a few weeks. They will include cost estimates, basic research and development needs and a time schedule for the proposed program.

Long-awaited decisions as who will build the two-service tactical fighters (TFX) is due to be announced this week. A last-minute delay occurred last week but Defense Secretary Robert McNamara's office and Air Force and Navy were reported to have gone ahead with TFX by Nov. 29. Boeing and a General Dynamics-Gates team are the finalists. In the meantime, administration of the test, USAF and Secretary Joseph S. Gandy said last week, "When the winner is decided upon, he and the government will know more about the task to be undertaken than any previous procurement of a complete new system."

Watch for Rep. John W. Moss, Democratic chairman of the House Government Information Committee, to continue his efforts on the Kennedy Administration's handling of news during the Cuban crisis before the House Armed Services Committee on Nov. 30. Rep. Mo Udall, Democrat, which has raised the "漏泄新闻" contention, has since withdrawn from the committee. Since late 1963, he has been far less active since the Democrats took over the executive branch than it was when Republicans were in the White House. But the widespread criticism of the way Cuban news was controlled is expected to result in public hearings early next year (AW Nov. 32, p. 23).

NASA Information Plan

Plan to make information offices integral parts of NASA's main program offices has finally taken effect, in spite of one last minute quibble that it will be partly incompatible to their traditional chief. Jim Stro, former deputy public information director, shortly has moved into the advanced research and medium payload program office. Paul P. Haug, former news chief, has moved to mission flight. Alles J. French has been assigned to the environmental programs office for several months. Walter A. Fossen, former coordinator of information for international trade fair at the Commerce Dept., replaces Stro. Fossen will now have a relatively small news room staff to deal directly with the press and public.

France will have nuclear bombs with yields of 60 kilotons by 1984, according to the official French publication National Defense Review. Nuclear strike force initially will consist of Dassault Mirage 4 bombers and Dassault Etendard IV strike aircraft.

—Washington Staff

Webb Minimizes NASA Money Problems

Other space agency officials admit serious fund shortages; no supplemental appropriation bill is seen.

By Edward H. Koloski

Washington—Space program funding problems were minimized last week by space agency chief James E. Webb, but several other key agency managers admit that serious money difficulties exist. They blame them on poor management by themselves and prime contractors.

In a New York City speech, Webb said the space program is "pressing on schedule," and that the National Aeronautics and Space Administration does not foresee the need for a supplemental budget request during this fiscal year. That is a solid defeat for several of Webb's top assistants who have been pressing for supplemental money, which they consider mandatory in order to keep the nation's space flight program on schedule.

Congress already has been informed that the national space program alone faces a deficiency approaching \$300 million (AW Nov. 12, p. 27). This fall, it will be in slowdown when from NASA to several prime contractors, which eliminated some overtime or started to stretch available funds through this fiscal year.

Other NASA programs are experiencing deficits, although not to the same degree. Among these are Centaur (AW Sept. 3, p. 18), nuclear propellants and atomic science satellites.

Defending his program, Webb said: "Space program is ... a major program for us which is managed, driven, practically managed and effectively controlled."

Despite this, the senior manager that Webb refuses to seek a supplemental appropriation despite the severe underfunding of the program, is well aware that the U.S. will over-spend the two-year period 2015 which will total \$7.8 billion, according to current Budget Bureau estimates.

To those that factor some measure of Congress' feel that NASA needs supplemental funds and does not request them, it can select an Administration costing toward the major space programs applied not to President Kennedy's third offer for just off-the-top start.

Because of the damage done to its fiscal year 1968 budget, it is required a supplemental appropriation, so far, amounting to \$400 million.

On top of the major space programs, the budget for the lunar excursion module will be limited to about \$50 million. This fiscal year, NASA estimated that the long contract will be Gossard Aerospace Engineering Corp. (AW Nov. 12, p. 29), has a value of \$150 million. NASA is to begin the project came from reprogramming part of the SIVL mission in Fiscal 1967 funds intended for the long landing module, which will not be part of the Apollo system as the lunar orbiter module configuration.

The lunar logistics system, which some in NASA believe is a mandatory part of the Apollo project, probably will not get beyond the study phase until after Jana. This comes as expected to cost of less than \$100 million. Although Webb and the program is on schedule, NASA had officially set

Major Gordon Cooper's Mercury Atlas 9 flight two years ago, set for the last quarter of October 1965, as recently as Sept. 10. NASA had an April launching date but has since moved it to a better another property, yet some offices at Cape Canaveral say the delay has been caused by a cancellation in overtime.

In fact, Webb indicated NASA does not plan to award the Nova vehicle contract for another two years because it is not known how fast nuclear power can be developed for space propulsion, or whether solid propellants offer advantages over liquid fuels.

"They are those," Webb said, who believe we should begin major funding now of programs looking toward extended exploration of Venus and Mars and eventually leave the surface of the moon. The type of program was not listed in the agency's fiscal 1968 budgetary conference (AW Nov. 12, p. 25) by Abrahams. He said, however, that the final totals of several years \$70 to \$80 million more than initial estimates.

Possibly one of the major reasons that Webb refuses to seek a supplemental appropriation despite the severe underfunding of the program, is well aware that the U.S. will over-spend the two-year period 2015 which will total \$7.8 billion, according to current Budget Bureau estimates.

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First Details on Pegasus Revealed

Los Angeles—First details of the Martin Pegasus, a three-stage vehicle for space interplanetary trips up to altitudes of 3,000 mi., were disclosed at the 17th annual meeting of the American Rocket Society.

Pegasus is based on the Martin Flinging two-stage solid-propellant tactical ballistic missile (AW Apr. 5, p. 45). It may extend Flinging components to four and second-stage units, and could be handled as a standard Flinging launcher-transports.

Martin's aim in preparing the Pegasus was to develop a space probe system that would be low-cost, reusable and mobile. Low cost, the company says, is promised to ensure the research and development expenses already have been absorbed in a large degree by the Flinging program.

Vertically, Pegasus has the basic shape, which presents either a two-stage or three-stage orbiter, capable of those typical post-Orbital maneuverings:

- As a three-stage vehicle, Pegasus could cover every 1 to 213.8 mi., 500 lb. to 1,611 lb. 4 sec. mi., 100 ft. to 1,524 mi. sec., in about 95 ft. to 3,000 sec. mi.
- As a two-stage vehicle, it could loft a run to 205.8 mi. sec., 1,000 lb. to 175.5 mi. sec., 500 lb. to 239.7 mi. sec., 100 lb. to 311.7 mi. sec.

Reentry velocity ranges from 1,670 ft./sec. to a maximum payload carried by the two-stage version, in 21,100 ft., in the three-stage version carrying a 100-lb. payload.

Mobility is obtained by using the Flinging launcher-booster unit, designed to be used in a Boeing Vertilift Chinook helicopter. Martin says the vehicle could be launched from any location on earth-possibly within range of the proper ground instrumentation. At the air base, launch pad, flame deflector, stabilized nose and associated equipment, the booster system can be tested and launched by a dozen people in less than a day's time, the company says.

Side advantage of the mobility, which makes it possible to move the probing system easily to an operating area, is that it eliminates launching requirements. This is considered a major and vital advantage in longer-range problems. Martin also discloses parts of the Pegasus as it stands today, and the long lists of Apolo and Thor launch complexes at Cape Canaveral. The importance is that Pegasus could be set up and fired without modification to either the existing sites or schedules.

Martin says that all required components and subassemblies are ready for production, some are already in production for the Army Weather. Delays in the Pegasus can begin within six to 12 months from the date of contract, Martin says.

ARS-IAS Merger Approval Near, But Individual Doubts Still Remain

By David A. Anderson

Los Angeles—Approval of the proposed merger of the American Rocket Society and the Institute of the Aerospace Sciences reported earlier but work from early return of the members' step vote.

To approve the merger, a majority of both societies' voting units, and of that majority, two-thirds must favor the merger. By last Tuesday, about 40% of the ARS ballots had been returned, and about 85% of these favored the merger. Society records were not available for IAS returns, but about 49% voting so far, and 95% of those favoring merger. Ballots were mailed to the membership of both societies at the end of last month.

Rather Dr. W. H. Falingberg, outgoing president of ARS, at Dr. Martin Sommerfeld, president-elect of the aerospace, was expected to announce at the dinner next Friday that approval of the merger was an accomplished fact.

results as a and cost that in 24 bays that of the ARS alone," Sommerfeld said.

The nature of staff cuts and impact on general is one that has caused those governmental officials whose agencies point to funds to support aerospace publications. One tends to draw the conclusion that the funds available will not be enough to support aerospace needs to pursue its a cause other funds to support our aerospace goals," he added.

"The new may be too extreme, but I am sure there is an element of truth in it. I think, we will have to take steps in the new ARS to bring down the individual costs at least in ARS levels or we will simply have to raise the dues and cut back on our publishing program," Sommerfeld said.

Second major hand is the thinking of the ARS board, Sommerfeld said.

To some of the new board members, these ideas as society government reflect to direct, rather than indirect, as political, areas. In other words, Will direct and important, will the new ARS board have the same strong support in the field of astronauts that the ARS now heard, that is, the kind of enthusiasm that led to the existence of the ARS? If do not know."

Opponents of postive legislation proved to be the main stumbling block during the year of negotiation, according to Sommerfeld. The purpose of the legislation was to accomplish three goals—promotion, direct funding, and the right of association by partners, mention control, by technical committees over the uses and conduct of technical meetings, and define the public policy of the ARS.

"We wanted the ARS to have a democratic structure process to allow all members to vote directly ballot for its officers and its board, and we wanted to guarantee to the members the right of nomination by petition in case the nomination machinery should ever be registered by no notice stage. This is the status we have in the ARS, but it was first applied at first by the IAS named." That issue was resolved ultimately to continue in ARS practice, Sommerfeld said.

In the ARS, according to the merged agreement, the technical committees will have complete authority, subject to policy decisions of the board, over the calling of technical meetings and the acceptance of papers for publication, setting up in the ARS."

Finally, the question of publications policy was resolved in the manner ARS had requested. Two persons will be published—AIAA Journal, and Aerospace and Aviation, "this body will be open to all members, with subscriptions fees covered by their dues."

Coupe to Fly Ma-9

Washington—U.S. Rep. George Cooper (D-Calif.) has been selected to fly the second Mercury Atlas 9 mission which NASA set up to be scheduled for April (AW Oct. 1, p. 22).

Major Cooper's backup pilot will be Col. Alan R. Shepard, who flew the first manned Mercury capsule on a suborbital flight last year (AW May 15, 1960, p. 31). Cooper, the youngest of the original seven Mercury astronauts, will be the sixth U.S. astronaut to make a space flight.

Van Allen Radiation

Cambridge—Dr. James A. Van Allen received for work that the observational data obtained from the Pioneer 6 and 8 and 10 and 14 and 15 (see p. 390), on the artificial radiation belts created by the nuclear weapons tests, to plasma electrons substantially in agreement with the theoretical predictions he made ten years ago.

Intensity and lifetime of belts have been found to be apparently less than stated in the August report on the tests which he issued ("Radiation"). Van Allen speaking at the New England regional conference on science, technology and space under the joint auspices of NASA and MIT and Massachusetts Institute of Technology, said he was surprised to find that some of the data he had obtained was destroyed as a result of the blast, but has submitted



UH-1B Research Helicopter Exceeds 175 mph.

Extensively modified Bell UH-1B transports are carrying out a U.S. Army Transportation Research Command program studying the possibilities of significant performance improvements in existing and future helicopters using state-of-the-art knowledge. Twin-turboprop research UH-1B has extensive fairings installed on all fixed rotors and mounted over propels, and landing gear has been strengthened and other modifications deleted or fitted over to reflect day of tomorrow's requirements. Main rotor disc can be rotated 90° and main rotor blade flange strike during forward flight, reducing drag and loads on engine nacelle. The configuration, which is part of a continuing study on increasing speed and range without boosting power, has attained top speeds exceeding 175 mph., which is 40 mph greater than top speed of standard modified UH-1B and about 25 mph greater than the existing world record set by this class helicopter.

Budget Bureau Sees Deficit of \$7.8 Billion

Washington—Kennedy Administration now expects to end this fiscal year on July 1 with a \$7.5 billion deficit, rather than the \$600 million surplus predicted last January when the President submitted his budget to Congress.

Budget Bureau blamed the deficit largely on the failure of the national economy to grow as much as expected, but also cited tax increases which cut the government's income, defense reduction of dug-in transportation from 10% to 15% affecting Net 35.

Although the Bureau still expects the Defense Dept. to spend \$42.5 billion this fiscal year, as predicted in January, the Administration said it will ask Congress next year for \$41.8 million in supplemental funds to cover costs of the Cuban crisis and other emergency spending.

The Bureau also predicted the National Aeronautics and Space Administration would spend in fiscal 1963 the \$2.4 billion forecast at January. Although the Bureau did not announce any intention to add the supplemental funds NASA will need extra money for the development of the space shuttle and the construction of the space station. The Bureau also predicted that its programs received last year by Air Force, Navy (AW) Nov. 27, p. 27). The space agency last week confirmed it is short of funds and that its basic budget

program is behind schedule (see p. 28). Last month the Budget Bureau predicted the government would total in '63 \$10.5 billion, up spend \$9.3 billion, but as far as we've looked, changed three predictions to receipts of \$8.9 billion and expenditures of \$10.7 billion, or a deficit of \$5.5 billion.

GE Begins Forming Apollo Support Unit

Washington—General Electric has started organizing its Apollo Support Dept., which is eventually to include several thousand persons with headquarter at Edwards Beach, Fla., and branches at Cape Canaveral, Manned Spacecraft Center, Houston, Tex., and Marshall Space Flight Center, Huntsville, Ala.

Early this year, the company was awarded a National Aerospace and Space Administration contract for systems analysis, cost-of-reliability and development and operation of a vehicle checklist for the entire Apollo system.

General Electric has been developing a detailed study and planning analysis and the contract now moves into its implementation phase. There have been estimates that the award will become one of the largest single contracts in GE history.

Ronald L. Shaffer, general manager

of the company's Guidance System Division, of which the Apollo Support Dept. is a part, will head the new group, with John E. Raccio as program director.

The company expects to have several hundred employees at its Daytona Beach facility before the end of this year. In addition to Shaffer and Raccio, key managers at this facility are Robert S. Gossert, head of advanced engineering for the Atlas program; Joseph F. Koenig, manager of the Saturn program; Dr. Austin H. Salas from manager of the GE Spacelab Division; Operations Dept., which is eventually to include several thousand persons with headquarter at Edwards Beach, Fla., and branches at Cape Canaveral, Manned Spacecraft Center, Houston, Tex., and Marshall Space Flight Center, Huntsville, Ala.

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Guantanamo Bolstered by Massive Airlift

By Larry Books

Guantanamo Bay—In a period of 70 hr beginning at 9:37 a.m. on Oct. 21—more than a day and a half before the U.S. announced its mass blockade of Cuba—airlift and seaborne unloaded and served 130 military transport and cargo aircraft at the Lewiston Point pt landing base.

This massive airlift of men, equipment and supplies was done with Douglas C-130, Lockheed C-130, Beech C-135, Fairchild C-119, Douglas C-115 and Lockheed C-121 aircraft.

The reason that such a task could be accomplished so quickly is the urgency presents.

The improved Marine landing assault force, which includes the mobile public works units, a contractor unit with units of construction (MILCON) among the march and march-moved hills on the eastern part of the island.

The high degree of mobility resulting from the improved kinds of operational flight procedures, including a Detection and tracking of submarines. Both the P-3V and S-2T aircraft have flown thousands of hours in search of Soviet ships proceeding toward Cuba, but submarine detection gear is operating full time.

Although the UH-1 and CH-46 "Sea Knight" aircraft are flying from the fields here, they have participated in the sub-

marine tracking operations, flying down ASW routes. One patrol plane reported a submarine, which was about midnight two weeks ago, rolling at a "positive contact." At dawn a helicopter and a destroyer were ready to close in on the target. Soon the helo pilot called "Contact submarine contact." The patrol plane commander broke in, "I don't believe you." The submarine had run for cover.

• **Fighter and attack flights.** The F-8U, A-4D and AD-4 aircraft are rapidly moving in as alert aircraft. Flight operations consist of constant patrols along coast and deep flights involving the dropping of small practice bombs on the salt flats or the northeastern section of the mud flats. These data can be sent from the rows of Casuarina, half a mile south of the navigation base.

• **Helicopter operations.** Marine HU-16 helicopters maintain continuous patrols along the fire line during daylight hours. The helicopters also are making daily flights between McCall Field and Lewiston Point, clearing the bush road across the leather marsh.

In consequence, the emergency command center, the regular military command center, the ground command center which had started the morning of Oct. 18. These centers were held every morning for the last two years. During the extreme heat of the winter, married commandants in the hills in the east, including regular Marine force leaders reporting for duty spent two weeks in "Division X," having to operate seven weapons.

Sixty-five days earlier on Oct. 21, the message announcing the beginning of the aerial assault came through the radio nets of the airfield control tower which could be passed into service was sent early in the morning of Oct. 20. By 10 a.m. all of them were back and had a shower and breakfast.

A message was sent to all command posts in the airfield in field phones and telephones to permit them to return to a U.S. standard airport without arriving here, but radio were already on the air. The first day's activity therefore involved not only unloading assault but arriving them.

The force of about 400 sailors was augmented by 110 Air Force personnel that day. Cargo was loaded aboard trucks which were taken across the bar for safety in two automobile former small boats who were passed into service. During the 75 hr period, as many as eight planes were being unloaded on the strip at one time. Lewiston Point consists of the marine and naval

I-28s, Inspection Still Bar Cuba Settlement

Washington— Soviet Union's apparent removal of 42 medium-range ballistic missiles from Cuba during eight January ship drops (p. 16) had not resolved the Cuban crisis by late last week. The U.S. still insisted on removal of B57 bombers and missile superiority, while Russia and Cuba stood by Foreign Policy Council's five-point resolution, which includes U.S. withdrawal from the Guantanamo Naval Base.

The U.S. arms blockade and aerial surveillance continued, and Deputy Defense Secretary Russell L. Christopher and the U.S. would never "bargain away" its right to air sovereignty, which is "part of our right of self-defense."

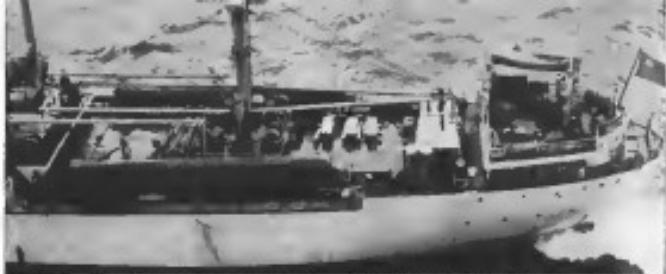
U.S. officials at the United Nations continued talks with UN, Russia and Cuba delegates over a Soviet-Cuban proposal aimed at settling the dispute. Details of the proposed settlement said that there were other indications that Russia was not pressing Cuban to leave the longrange weapons in its interests that the U.S. have Guantanamo, and its blockade and surveillance purposes against invasions by U.S. or Cuban nuclear groups and personnel.

Negotiations to have International Committee of the Red Cross handle inspection of all ships bound for Cuba (AW Nov. 13, p. 36) are supposed to begin nowhere.

Using ships, assault and helicopters, U.S. Middle Eastern photographed and "spotted" three Soviet ships on Nov. 9, 10 and 11—the *Kharkov* and *Amur*, with eight missile units each on their decks, the *Lev Tolstoy* and the *Bratsk* with two each, the *Vologda* with seven, the *Kirov* with six, the *Poltava* with four and the *Dnepropetrovsk* with four. Equipped were pulled back in some cases from the missile sites as powered with waterproof ratings. All inspection was made from ship-to-ship.

Cuba said on Nov. 12 that "we could never be sure that it was the maximum number" of missile bases not to Cuba "until we have counted missile superiority of the island." Administration spokesmen stuck to this position throughout the week. There was unconfirmed reports that a blockade of oil and gasoline might be imposed if Russia and Cuba continued to refuse to remove the B57s, which Soviet troops at the UN base had seen the property of the Cuban or their.

At Shannon Airport in Ireland, the Blue Diamonds Corps was using a cargo aircraft to move Cuban and Czechoslovakian aircraft (AW Nov. 12, p. 36). That aircraft was used by a CSA Board Beltrona flying from Prague to Herren with 77 Cubans, Czechs and East Germans passenger. No military equipment was found



Removal of missile一枚 from the deck of the Soviet ship Bork. Shows similarity of configuration to the latest version of the Skoryi MRBM below, photographed at the Nov. 7 Balaklava port in Moscow. Although short anti-aircraft ring armament slightly raised short at visible. With one exception, Skoryi shows below carries about 10 ft long WSR-20 or 15 H-20 cruise, as on the ship, dimensions correspond closely with those in U.S. photo reconnaissance pictures of Cuban MRBM units (AW Oct. 25, p. 34).

U.S. Monitors Ships Returning Red MRBMs From Cuba



Both survivor missile on the Soviet ship Tbilisi, photographed on the same day as the Baltic Nov. 8, indicates a truncated delta configuration instead of the delta shape on Skoryi (below). Skoryi photographed at various Western ports reveal differences in hull length, fin shape, skirt and forward fin extension planned or electrical train.



Aeros Isosmack in Cuba missile transporter is caught in an unusual photo of a Lockheed P2V Orion of Patrol Squadron 41 and the destroyer Bear monitoring the progress of the Soviet ship Amur (below). Amur (in another view below) is carrying eight missile transports with unanswered MRBMs. Note Amur's revised mastlike, indicating lightweight nature of load, like that on the Soviet freighter Polotsk photographed earlier arriving home in the English Channel (AW Nov. 12, p. 32). PTM was deflected in their operational apportion late in the mission (AW Sept. 27, p. 81).

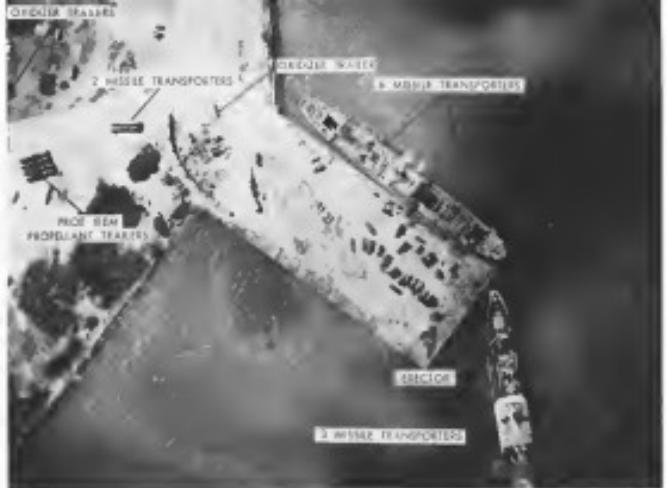


Soviet freighter Tbilisi Kuznetsov (below), photographed Nov. 5, carries a unanswered missile exports as well as its own-covered missile transports.





Three Russian freighters, each loaded with four missile trailers, arrived Nov. 2 at the major Cuban naval base of Mombasa, 10 mi west of Nairobi. Besides equipment designated, Defense Dept. and some missile launch pads were present. The missile carts on these ships carry warheads in a vertical position.



Loading of Soviet MIRV missiles, launchers, trailers, fuel and oxidizer tanks and other support equipment monitored by U.S. photo reconnaissance at the Cobano naval port of Mombasa showed progress steady over a two-day period. Equipment was at dockside and loading of three ships was getting under way Nov. 2 (left, top). On Nov. 3 (bottom) the freighter *Rodina* (far left) docked, the *Konoval* (top), with three missile transporters and one fuel trailer off the dock and six missile transporters on loaded on the *Azov*. Two other missile transporters are on the dock, probably destined for the *Azov*, which departed with eight. Also visible are four propellant trailers and eight oxidizer trailers. Expanded sections of the same dock area (left, below) show four large and 19 smaller fuel trailers and 13 oxidizer trailers besides the four missile transporters designated. Another ship at Mombasa the same day (right) received 17 cm-circumferenced missile casings, and 16 missile streaks, 12 of them loaded on the *Azov*. The four satellite ones are designated 41 S, mounted 41 missiles on eight Soviet freighters as of last week. Besides the Azov, the list was Leningrad, now British, now Komsomol, right; Kirovets, ex-Demjanik, front; Volgograd, ex-Komsomol, far.



Saturn SA-3 Aimed at Further Testing Engine Cluster Concept

By George Alexander

Cape Canaveral—Third flight of the Saturn C-1 launch vehicle, selected for late test work, was programmed to be a stiffer test of the clustered engine concept because the power plant, C-1 flights and, in addition, was to serve as a testbed for a number of C-1 Block-2 motors and propellants.

Built by the National Aeronautics and Space Administration's George C. Marshall Space Flight Center, Huntsville, Ala., the third Saturn-designed SA-3—was a Block-2 vehicle like the SA-1, SA-2 and the yet-to-be SA-4 boosters.

Block-2 vehicles will be introduced onto the flight test program with SA-5 around January 1963, and for Atlanta, 1964 flights will be differentiated from Block 1 tests by increased propellant capacity, updated thrust and the addition of stabilizing fins to the aerospike (AVN July 2, p. 11).

SA-3 was to be loaded with 750,000 lb. of liquid oxygen and kerosene-like RP-1, an average of 135 lb./sec. to SA-1 and SA-2. Because of the greater propellant load, SA-3 was programmed to burn approximately 30 sec longer than its predecessors and consequently fly a higher and longer ballistic trajectory down the Atlanta Missile Range.

Thus either of the earlier vehicles' maximum altitude of SA-1 was expected to be 104 mi., compared with 144 mi. for both the SA-2 and SA-3. Burned propellant margin was expected to be 270 sec., compared with 225 sec. measured for SA-2 and 215 sec. for SA-1. Velocity at burnout was to have been about 4,800 mph., or roughly 400 mph. faster than the preceding flights. SA-1 was successfully flown Oct. 23, 1961, and SA-2 Aug. 23, 1962.

Because of the greater weight it was to carry, SA-3 was to have accelerated more slowly than either SA-1 or SA-2 and, in so doing, place heavier demands on the flight control and propulsion systems than has been experienced to date.

Relegating much of the ST 128 stabilized platform, a major element of the C-1 Block 2 serial production package (AVN July 3, p. 31), was to be flying open-loop and its performance assessed.

Other Block-2 items carried by SA-3 included four solid propellant attitude rockets programmed to fire for 12 seconds, division of the four clustered engines but which were set to offer high separation, and six small stabilized pods for a regular Block-1 motor if the best should just above the engine compartment.

SA-3, which was expected to develop about 1.1 million lb. thrust on its eight RL10B-2 engines, was also instrumented with 716 telemetry channels. Of these, 612 were in flight channels, reporting data on such parameters as engine exhaust temperature and pressure, temperature in engine bearings, heat exchanger outlets, oil inlet and turbine exhaust, pressure in combustion chamber, propellant tanks, thermal aspects, maximum dynamic forces exerted on the vehicle, performance of the ST 124 platform, engine gobbling propellant levels, conditions with engine cut-off, battery voltage and current and receiver frequency.

Relegating the experiment line conducted with SA-2, the vehicle was to have been deliberately destroyed after burnout of the SA booster so that the 91 tons of water ballast in the booster second and third stages would be ejected into the upper atmosphere.

Experiment, called Project Highwater, is designed to study various characteristics of the ionosphere through the effects of that plasma on the ion cloud formed by the water. Detonations are planned to occur at the apogee of the trajectory, at about 184 sec. or 35 sec. after liftoff.



Engines Installed on Saturn SA-5

Six of the eight engines that will power the 1.5-million-lb. boosters SA-5 will be placed at National Aeronautics and Space Administration's Marshall Space Flight Center, Huntsville, Ala., as the first of the Saturn Block-2 vehicles. It will be the first Sats with full fuel-charged tanks for reuse, propellant will carry a low-stress stage.

To give a boost to booster rocket production, specialists at Lukens "spot" heads in the widest range of sizes, shapes and materials available—anywhere. Important uses for these versatile metal domes range from rocket and closures to missile nose cones...from oxygen storage tanks to huge industrial boilers. Lukens heads are produced in diameters up to 21½ feet, in thicknesses up to 7½ inches. Technical assistance on materials selection and design is always available. Write or phone collect: Manager, Apparatus Engineering, Lukens Steel Company, Coatesville, Pennsylvania; Telephone: CUDley 4-6200.

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National Space Agency will evaluate the S-66 satellite tracking system. The agency will evaluate the S-66's performance in space, its reliability, and its cost-effectiveness. The agency will also evaluate the S-66's potential for future applications.



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GENERAL DYNAMICS has been involved in the development and production of space-based communications systems for over 20 years. Our experience in satellite communications, navigation, and remote sensing has led to the development of the S-66 satellite tracking system. This system is designed to provide accurate and reliable tracking of satellites in space. It features a compact design, low power consumption, and high performance. The S-66 is currently being evaluated by the National Space Agency.

GENERAL DYNAMICS CORPORATION

NASA to Evaluate Laser Radar In S-66 Satellite Tracking Test

Washington—Space agency will evaluate the laser radar for passive satellite tracking using the S-66 polar-orbiting testbed satellite scheduled for launch early next year. The experiment will be conducted at the Wallops Island, Va. facility.

The mission has an intrinsic infrared resolution from a pulsed rate. Infrared will be used at the S-66 and reflected back to a photo multiplier tube from nearly 100 km. The corner reflector attached to the satellite. Both the laser source and the receiving tube, being provided by General Electric's Missile and Space Division, will be mounted on an optical tracking telescope mount.

Radio Corp. of America, which plans to participate in the S-66 program as a subcontractor, has been building a similar laser radar under contract funding (AW Oct. 29, p. 67).

The National Aeronautics and Space Administration's laser radar will use a fast, long-life rod, operated at the site

Finland Orders MiG-21 Jet Fighters

Russia media now plan to replace its Folland Mk. 1 Gnat fighters with supersonic MiG-21s purchased from the Soviet Union.

Domestic media say the first time Finland is buying will depend on Russia equipment trade considerations rather than political motivation. In behind the scenes

Under the 1947 Finland peace treaty, which officially ended the war between Finland and the Soviet Union, Finland's force was restricted to 60 combat aircraft and 1,000 men. The air force was also forbidden to operate bomber-type aircraft or to possess combat aircraft equipped with any type of guided or unguided missile or nuclear weapons.

Since 1947, the Finnish air force has never been up to full strength authorized under the treaty. Its main combat strength consists of around 100 MiG-17s ordered in 1956 and delivered in 1958. Remnants of the air force consist mostly of Finnish Fokker Magister jet trainers, some de Havilland Vampire and two Boulton-Paul P.112s used in target training.

Finnish defense in May MiG-21s was made over a year ago but was never implemented. The planes deal directly with the Soviet Union but have been flying it enough to differ from that export to Russia with imports from that country.

The Soviets at usual sold well Finland on a better deal. Having already ordered some 100 weapons from Russia, the Finns apparently decided to take their trading position with Moscow by buying supersonic fighters.

Some Finnish observers believe the MiG-21 deal was arranged at the highest level by General Secretary Leonid Brezhnev and Defense Minister Nikolai Kondratenko after talks between the 1974 treaty. Estimates vary to Moscow and Moscow the Russians were not used to the treaty.

It was during this period that the Finns probably decided to once again trading position with Moscow and study Soviet exports about Finnish necessities. In being Soviet weapons itself.

Reportedly, Russia originally wanted to buy Finnish planes on MiG-21s. The Finnish government refused to permit that and instead and Finnish pilots and ground technicians for training in the Soviet Union. Over the past year at least four MiG 15 two-seat trainers were flown from Soviet bases to Finland by Finnish pilots.

The opportunity for Finland to be forced to buy MiG-21s by Russian contractors before arrival of the supersonic MiG-21s.

Finnish government hasn't disclosed how many Soviet fighters have been bought. Observers here estimate that about 20 MiG-21s are involved.

multiplied to the appropriate satellite position. If the tracker is not perfectly aligned, the reflected laser signal will be received off-center on the image orthicon. This will generate an error signal for correction of the sight. Astronomical observations are new sequences expected to be able to derive the satellite position to within about 5 km of arc.

The NASA laser radar program is under the direction of Dr. Werner H. Purkin of the Goddard Space Flight Center.

Mariner Experiments Resume; Power Back

Washington—Mariner 3 passed the 29 million km altitude mark today on its flight from Earth to Venus after the failed initial approach corrected it still after the loss of its power source equipment. The probe is now about three-quarters of the way down to eight days before its closest approach.

National Aeronautics and Space Administration has observed that there was a short in the solar power conversion loop which caused the power output to drop to a level of 150 W watts at Day 31. The science experiments were interrupted at that time. When they were reactivated on Nov. 8, the available power was 250 watts. Science experiments are about 30 W with power.

The probe is expected to pass Venus on Dec. 14 at a distance of 32,900 km. For the remainder of its flight to Venus Mariner 3 is scheduled to apply dust on magnetopause mapping, particle flow, comet dust and the spectrum of the outer plasma. Ten hours before the Venus encounter, enhanced ion monitoring instruments are to be activated.

The signal reactivating the outer planetary experiments was sent from Leti Propulsion Laboratory's Goldstone Station No. 8, when the probe was about 15 million km from Earth. Command signal was received by Mariner SE Tissue after transmission.

Rolls Revenue Declines In First Half of 1962

London—Revenue of British Aerospace Ltd., for the first half of 1962, dropped \$2,248,000 to \$104,000,000, compared to a year ago, for a total of \$14,258,000.

Rolls and the major portion of its operation was attributable to a smaller program of deliveries for automated engines and wings. An automobile business also has declined.

Company also predicted its total revenue for 1962 will be about \$194 million, a drop from last year's figure of \$144.4 million. Work force, as of September, has been reduced from 41,953 a year ago to 41,300 employees.

India Seeking Stronger Defense Industry

By Cress Bowles

New Delhi—Concerned Chinese attacks along the Indian frontier are spurring new defense links for India and Canada, and included Canada-based C-130 transports, communications, machine tools and computer linkups to strengthen a now largely non-existent defense industry.

Request for the C-130 apparently includes a proviso that the aircraft be provided as a loan or lease basis. This is in view of India's mounting debts incurred in the U.S. and other Western countries since and began flowing into the country following China's Oct. 30 shelling of mostly unpopulated border areas of Ladakh and the northeast frontier. (AVW Nov. 3, P. 2)

The request was under consideration by U.S. officials.

U.S. has signed a loan over its production line priorities as two de Havilland Canadas to the Indian government (AVW Nov. 12, p. 29), which it had planned to acquire as four long-hauls in medium transport roles.

Air Supply

In the days ahead all supply must come by air, either through punctuate drops in aerial landings or improvised emergency storage at strategic locations up about 14,000 ft and using up to 10,000 H.P.

Emergency supplies will be paid for at rates of \$1,000 per hour, minimum-rate Indian basis, at well above all U.S. military aid to India.

Canada who has agreed to send India several C-47s to ease the strain on present transport fleet, which consists primarily of Avon C-47Ps (AVW Nov. 12, p. 127) and C-65s plus one Avro India Super Constellation.

New Defense Minister

New Delhi—Post of Indian defense minister—vacated by the ouster of V.K. Krishna Menon over general dissatisfaction with the army's state of readiness at the beginning of the conflict with Pakistan—will be taken over by S.R. Chavan as chief minister of state of Maharashtra.

Date for Chavan's ascent into his new portfolio has not been set. Defense duties were taken over temporarily by Prime Minister Nehru after Menon's removal.

Menon knows he is heading out of the West, who apparently will not return this year to his England post as Indian delegate in the United Nations.

which have been taken over with their crews during the present emergency.

Indian air force flight crews and ground personnel are now being dispatched to Canada for training on the C-130s.

India's Prime Minister Jawaharlal Nehru and last week he had been visited by the Soviet Union who the Chinese struck that Russia still had a poor commitment to supply India with a "specimen" batch of aircraft models 12 and 21. MiG-21 deliveries begining in mid-November, plus hardware and technical knowledge to build the aircraft in India.

MIG-21 production plan, Nehru said, is "the first thing" in the agreement, as far as India is concerned. Other agreements are not so specific that the Soviets will respond with MiG equipment, but India is, at whole, no longer facing being left out.

Some believe Nehru may deliver "specimen" aircraft originally built for test while shifting all construction work at production facilities—a point on which the Soviets were reluctant to agree orally and probably would have accepted if India had not warned it would turn to the West if it could not be obtained.

If the full MiG deal should fall through, India probably will still turn to the West for an assault warplane capability. On an informal basis, India has approached others here in the region, not Americans, others here in the possibility of obtaining an aircraft with a performance capability roughly comparable with that of the American Lockheed F-104C.

India also probably will ask, as will the U.S., to provide a limited quantity of helicopters capable of high-altitude performance for dogfights and low altitude combat aircraft in the undulated hilly-terrain near Jammu and Kashmir.

Whichever fighter India obtains it is likely to present using Hawker Hunter fighter bombers at a substantially reduced cost than the present fleet. India is an post-industrialized path to follow in general commerce has largely centralized defense, and high costs of modern weapon systems.

The Chinese attack has shaken Indian leaders considerably, although not to the point of abandoning their non-aggression policy. They hope to build up a broad-based military production capability as fast as funds, foreign aid techniques and availability of certain raw materials permit.

Present efforts, however, in large part to maintain products except for a number of areas of defense armaments left behind by the British.

and the move will be largely a matter of priority rather than of conversion.

Export and imports of U.S. and will depend primarily on India's ability to build that capacity in that field. U.S. industrial specialists already have moved here an advisory committee and an American observatory and service team will serve as the next to help assist the industry and programs.

India also has made formal requests to the Soviet Union since Oct. 20 for several military items, including MiG-21 fighters. Russian insertion to date has been generally negative, although a quota is still under formal consideration.

Chinese moves to the immediate north of the Sino-Indian border to supply India with MiG-21s has been seen as another further Russian influence and India could create a strong and escalating political rift between the two communist nations and their respective allies.

MIG planes is doubly threatening to the Chinese, whose interests for the MiG-21 have fallen on deaf ears so far the Kremlin.

Aid Requests

India appears too hopeful that any of the military aid requests after Oct. 20 will be granted by the Soviets or others interested over the expected demand. They hope, however, that the requests may be met at least partially since India at least deserves sending military equipment to both combatants for the moment.

India's big bet is in transport aircraft to carry supplies to the front lines that may have moved in the rear areas. This fits in with India's scrupulously avoided using combat aircraft in the undulated hilly-terrain near Jammu and

European V/STOL

West German Defense Ministry officials are quietly discussing purchases in Belgium, Holland, Germany and Italy in an effort to promote economic development and production of a V/STOL combat-support fighter to replace present fighters.

More to bring more because it appears almost certain that there will be no final agreement on North Atlantic Treaty Organization's (NATO) competition for a V/STOL combat and fighter will produce its own assault.

Aircraft proposed by the Germans would be built around a version of the British-built BAC 1-11 aircraft with

for this appear to be political as well as military.

On the political side, the Chinese have positively declared that they oppose any greater defense alliance and lightning rod status attached. Use of strike aircraft on any side would triple that threat.

India with as far fewer forces in both quantity and quality of equipment, have no desire to reach off a major war especially once the spawning sites along the Ganges would be particularly vulnerable to an attack by Soviet-made Franken-B-52s and Boeing B-52s.

From a military standpoint, the biggest factor of the conflict would remain. Under the present circumstances of both sides being used on borderlines quick reaction forces in areas of both threats, including those of short range missiles, will be vital. No side has as much as yet stated to a strike role under such conditions.

There is speculation on this regard that India should do support to themselves to damage the Chinese as an all-out spring offensive, if any along the "low and slow" technique being used as Vietnam.

Lack of aerial reconnaissance also has handicapped India's capability to assess Chinese offensive moves, particularly the raising of troops from high plateau. In this role the Huanlun as the Indian side of the disputed border.

Night Raids

Supply flights are hazardous, with current Avon C-47s and C-130s being moonlighted, improved an average to dry run, but at altitudes as high that flight crews cannot climb them to gain what is on the ground with any kind of starting time again.

Landed C-117, adapted for assault use the Hawker 1000, a 3,400 lb three-Windowpane/HM-1000 cargo plane measured on the center wing span, reportedly set a record for the operation to date by setting down on an auxiliary stage at 16,000 ft altitude and then taking off again.

An Avon C-47, modified to infinite flight crews, should be regularly flying equipment into Ladakh, where the terrain is a 15,000-ft long dry river bed at an altitude of approximately 14,000 ft. At night, search lights are provided by individual soldiers along either side of the river bed, each carrying a flashlight.

Meanwhile, requests for aerial aid continuing, including daily requests to the U.S. according to Prime Minister Nehru. In all, India is sending out seven requests to 11 nations including Yugoslavia, Poland and Czechoslovakia, in accordance with India's political policy of nonalignment. Both imports and exports probably will continue to move from time to time.

Present efforts, however, in large part to maintain products except for a number of areas of defense armaments left behind by the British.

C-135s Flying Indian Airlift Show USAF's Quick-Reaction Capability

Calcutta—Emergency U.S. Air Force Boeing C-135s flights of light equipment, armament and communications systems via India provided concrete evidence to the Soviet Union and Communist China that USAF's quick-reaction rate in a major war would be fully independent, at least according to officials.

Flights showed that USAF can make prompt response to limited immediate needs although the aircraft had been used on borderlines quick reaction flights in areas of both threats, including those of short range missiles, will be vital. No side has as much as yet stated to a strike role under such conditions.

Flight tests on this big warplane were required about 40 hr after the Aden strip. The planes then flew a northward course over Thailand, Laos, Vietnam, including back south into India. This route was plotted to avoid the territory of Pakistan, a Western ally that still trading with India over Kashmir territory, and to keep the route as secret as possible.

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S-61 Modified for USAF Order

First details of the Sikorsky S-61R to be produced for the Air Force as the CH-3C are revealed in an orbit concept showing extensive modifications from the Navy SH-3 Sea King formerly HSS-2. Tell avionics is redesigned for rear landing skid using a hydraulically operated split-type cargo ramp, and the panels at the front of the cabin are hinged so they swing out to the electronics compartment. Powered by two General Electric T58-11 turbines, engines of the CH-3C have a range of 215 miles with a payload of 3,000 lb, or 180 miles with 2,400 lb payload. Normal gross weight is 19,300 lb and maximum gross, 22,000 lb. First flight of the CH-3C is scheduled this June. Initial delivery is fiscal 1964. Air Force has requested delivery of an HSS-2 at the initial order of 15 ordered earlier via RFP and representatives (AVW Nov. 4, p. 24). Release of the next will be the S-61R version.

Twenty CH-3S light crews were involved in the operation, some making no more than three flights from Germany to Calcutta. Normal crew rate between flights was between \$13-\$15.

In addition, Gov. George Bush II announced a \$10-million equipment grant to the state to help fund the new base at Atoka. At \$7.25/Dam Dismantling Fund, the proposed costs add up, using 100 tracks and vehicles.

C-130s were offloaded inland in an average of 25 miles, with cargo going onto anticipated caulked roads drafted for the purpose. Cargo was then taken to a rail or another air center for final shipment to the base on a truck.

Only those that failed to reach Indiana or were unable were several pieces of construction machinery which, at the end,

Apollo Engine Test

Washington—Army General Corp has tested a full-scale prototype Apollo liquid propellant engine at Brooks AFB to 21,000 lb and durations of 16 sec. The Alstom engine will support the Apollo spacecraft from a fixed position, since it can't move off from base after initial ignition.

The engine runs on additive chemicals with the same propellants in the Titan 3 engine—urethane trioxide and Acetone. 10-minute ignitions. Overriding the failure limit, a 16-second engine test was done. This was the first time the engine had run for 10 minutes and the duration rate of the number here has been within Apollo specifications.

News Digest

Afghan F-84s successfully air-launched at Vandenberg AFB last week. Present AF objectives were to evaluate operational ground equipment and missile systems. Launch was made by SNC over from 3700 ft. Strategic Missile Squadron.

New York Airways Vertol 107 high wing with 25 persons aboard made a forced landing at Bellows AFB last Wednesday. The pilot had a bad landing and power drop shortly after takeoff. Maintenance work and failure of the gear dash assembly at the rear main rotor was suspected as cause of trouble. Transportion was sent to Boeing's Vertol Division for disassembly. Helicopter was returned to service with new transmission.

Korean K-4125 Helate 3 two-place, company-developed helicopter was damaged after hitting over following an unassisted landing last week at the front end of a house near the Korean plant at Bloomsfield, Conn.

John E. Lewis, manager of Washington, D. C., operations for United Technologies Corp., was killed last year in France. He had been chairman of the board and Mr. Lewis is cousin to Senator No. 10, Lewis, a brigadier general in the Air Force Reserve, who is in route from Andrews AFB, Md., to Rabat, AFR, Cr, where his workstation assignment was deputy chief of staff, operations, to the Constitutional Air Command.

Forra Riley communications satellite was shipped to Cape Canaveral, Fla., from Rockwell Corp. of Anaheim, Calif., on November 10. It is launched in December to provide telephone, television and data relay and ground level access to the electronic computer. Powered by two General Electric T58-11 turbines, engines of the CH-3C have a range of 215 miles with a payload of 3,000 lb, or 180 miles with 2,400 lb payload. Normal gross weight is 19,300 lb and maximum gross, 22,000 lb. First flight of the CH-3C is scheduled this June. Initial delivery is fiscal 1964. Air Force has requested delivery of an HSS-2 at the initial order of 15 ordered earlier via RFP and representatives (AVW Nov. 4, p. 24). Release of the next will be the S-61R version.

of the United States. The Turkish army had agreed to provide Turkey, however, later backed down on the offer of US-made equipment without committing to any specific date.

Other MATS flights into Celestial during the last indicated against participation by C-144s. Lockheed's first four Lockheed Air Bus, C-141s and C-140s from Rhein-Main Support equipment included one Boeing L-1, a lift truck for unloading and a maximum of spaces, including mail.

At other times, parts from missing aircraft supply were used to stretch any inductiveness in an ongoing plane

Monsanto Synthetic rubber private plane manufacturer owned by the Stoltz family, is reported to file a petition for bankruptcy this week after losing heavily in the oil.

Coast and Geodetic Survey announced last week that its surface tracking station at Aberdeen, Md., received for flights of an unannounced test of the ANNA satellite on Nov. 2.

Hughes MMRBM Role

Washington—Hughes Aircraft Corp has been selected by AFAC to join the program definition phase of the geolocation, assembly and checkout mission on the mobile mobile-range-homing missile. The Hughes-Northrop Corp.'s North Division and completed selection of fuel system and assembly of the MMRBM will be made by Hughes and a Matra-Selvavia team still are doing program definition work in the research and control section.

AIR TRANSPORT

Trunkline Profit of \$25 Million Expected

Anticipated 1962 earnings would reverse two-year trend; rate of return is still termed unsatisfactory.

By E. L. Doty

Washington—Domestic trunkline industry appears headed for a \$25-million profit for 1962, despite an anticipated slowdown in passenger traffic growth during the fourth quarter.

While this would be a welcome switch from the loss of \$34.6 million last year and the meager net earnings of \$1.2 million in 1960, it falls far short of providing a rate of return that can be termed economically satisfying. If the trunklines could realize the Civil Aeronautics Board's recommended rate of return of 10.35%, the industry this year would show a profit of \$13.7 million.

The highest rate of return reached by the industry in the last six years was in 1959, when a 7.1% rate was imposed. Total net earnings for the industry during the five-year period 1954-1958 and 1961 totalled \$800 million, or one of seven slightly above 4%.

Key to profit potential is the industry's ability to continue the traffic growth recovery that began last September, but which in recent months has shown signs of decelerating. Improved gross revenue will be required to keep pace with a rising expense level and a steady increase in interest on debt which is far for this year but climbed 13% over last year.

Interest costs will probably reach an estimated \$71.5 million this year, compared with \$61 million last year and \$29.5 million in 1960, when trunkline imports were first introduced into U.S. schedules.

The overall industry picture cannot be interpreted as representative of individual carriers. Seven of the 11 trunklines will undoubtedly show a profit this year, but losses expected at Eastern, Northeast and Trans World Airlines could seriously deplete total industry profits.

Eastern, for example, has reported a substantial \$13.5 million net loss for the first nine months of 1962, a figure close to the forecasted industry profit for the year. It has been said, however, that the carrier has, equivalent to \$7.25 per share, in effect, a \$16 million deficit. It has remained from other participants in the National Air Agreement.

The CAB has not given its final approval to the plan.

Industry revenue passenger rates will probably increase 9.5% over last year. Traffic remained fairly flat through

September, but fell in October 4.4%.

Meanwhile, available seat miles jumped to 336 billion in October, highest monthly level ever reached and a 13.1% increase over October, 1960.

As a result, the industry's load factor improved 4.38% in 1961, the first gain in 20 years. A 10-day break before the 1962 work

Only three carriers—Continental, Northeast and Northwest—showed a load factor improvement in October. American's load factor dropped 2.7%, TWA and United 4.6%, and Braniff 7.5%.

Fleet-wide load factor was hit particularly hard during October with no carrier reporting a load factor higher than 49%. Northwest's first-trip load factor fell 10% to 31%. Northwest's dropped to 18% and Western's fell to 30%.

Each of the 11 carriers experienced decreases in revenue passenger packages, most of them significant. For the group, first-class revenue passenger miles decreased 15.4% from the robust reached in October of last year.

Fleet availability and rates were reduced by 4% during the month but it was not sufficient to offset the steady

British Treasury Moves to Approve SST

London—There were strong indications here last week that the British Treasury has approved funding for up to \$100 million to join with France in building a Mach 2 supersonic transport. Airplane will be called the Concorde.

Decisions to proceed with the project will be announced in the House of Commons by Minister of Aviation John Stanley at this end of the month.

Eastern, Ansett and the French counterparts, Lignes Aériennes, met in Paris to discuss fleet substitution and technical details. Both countries have since reported to their governments. The ministers also discussed military versions of the aircraft.

Speaking in the House of Lords yesterday, Lord Charnwood, the parliamentary secretary to the minister of transport, indicated that the British financial decision will be made very soon. Supporting the project, he stated that cancellation would be a setback to British aviation in view of what he called a lead of several years in development of supersonic transports.

Charnwood also said that the government has spent \$2.5 million on supersonic transport research since 1956. If the joint project is funded, money would be loaned over a 15-year period (AWW Sept. 7, p. 3).

He commented following an attack on the same project by Lord Redesdale of Tint, president of the Royal Aero Club and a member of the Air Registration Board. Lord Redesdale questioned how much the government should spend for prestige projects and claimed that problem of fatigue and radiation in supersonic transports seems to be solved. On radiation, he said:

"It would be a tragic thing if you sent your best girl in a supersonic airplane and then found yourself the father of no progeny."

Referring to the costs of the project, and looking for cost-benefit that there is no need for such an aircraft, Redesdale contended that Ansett's construction policy would save civil aviation, from the point of view of paying, because

Reactions Mixed to UAL One-Class Trial

New York-Cited Air Lines' opposition to the Chicago-Los Angeles and Chicago-San Francisco routes have caused reactions to UAL. President W. A. Fitter says no plan to begin experimental one-class service on one of these routes by May 1, 1961, if Civil Aviation Board approves (see p. 42).

Fitterman elaborated as he outlined service plans (AVW Oct. 15, p. 41) recently at Dulles International. He said he would like the experimental route with CAL to Dulles to begin by May 1.

Four Boeing 720 jet transports would be needed in 23-seating configuration with 100-passenger capacity plus the lounge. Fitterman said, "A most real cost would be included in the service."

Potterman preferred the two-liner would not exceed 15%, which takes with the current 15% federal transportation tax cut, would have one-class fares at about the present coach level.

Twa World Airlines President Charles C. Tammage Jr., opposed the one-class fare, saying it would "reduce the customer appeal to first class passengers and cause a significant revenue loss in fares except by third passengers."

"The American consumer is used to making his own free choice—whether it involves automobiles, refrigerators or clothes—an important industry has to our knowledge sought to force the consumer to accept a single predetermined grade of product as service," Tammage added.

Continental Air Lines and it must evaluate its own business-class representation (AVW Aug. 25, p. 45), which it characterized as "unacceptable," had no say in the trial. Before it could comment on UAL's one-class plan, Continental planned to file its own extension of its proposal to April 15 to obtain maximum benefit from the proposed change the Civil Aviation Board.

American Airlines' Uniform One-Class operates on the Chicago-Los Angeles and Chicago-San Francisco routes with its management still looking for a route for transoceanic service as the airline market, but that it was studying Poterman's proposal.

United Airlines' president noted that seating on that carrier's Boeing 727 jet fleet new as yet, has been altered to a one-class, 82-seat configuration—three fewer seats than under the original coach, first-class configuration. The new seating is the same type United would use on its one-class 700s.

switch of passengers from first-class to coach will not affect the one-class.

All but Northeast reported gains in coach traffic in October. Indiana is down during the month as coach traffic in excess of the month's coach traffic rate for the south. American generated 544.7 million revenue passenger miles for the period, and TWA was in third position with 382 million.

Local service airlines continued to show strength during October with a 17% increase in maximum passenger miles and a load factor of 41.1%, only slightly lower than the 42.4% reported in October of last year. Only two local service airlines failed to show a gain in revenue passenger miles during the month.

Both carriers showed spectacular improvements in the volume of coach traffic handled during October. Delta reported an 89% increase, Continental 91%, Northeast 75%, National 58%, Southwest 50% and Western 45%.

The 45% increase in total revenue passenger miles for the 11 carriers does not reflect the traffic arrivals of unlinked carriers any more than the industry's total paid flight segments average indicated earlier.

Both Eastern and Northeast, for example, showed declines in revenue passenger miles. American, TWA, United and South reported slight traffic increases, but Southwest's total traffic dropped 23% and Delta's 25%.

It can be presumed that those two carriers are broadening down the coast extremes of their routes to the West Coast. Continental, Northeast and Western reported substantial gains in total revenue passenger miles.

During October, United held its pre-

clude other areas of likely consolidation throughout the country. The Board estimates that 18% of the 145 certified airports directly compete with each other. This competition is increasing to even more, since the Board's contention is only 36% of Hubs, 12% in Michigan, 25% in New York, 20% in Florida, 31% in Oregon.

The Federal Aviation Agency, in supporting the Board's regional airport program, has said it will not provide funds for airports being investigated by CAB. FAA noted that in several past cases it has required far less federal money to build a new airport serving two or more communities than it did to refurbish two separate airports located a few miles apart.

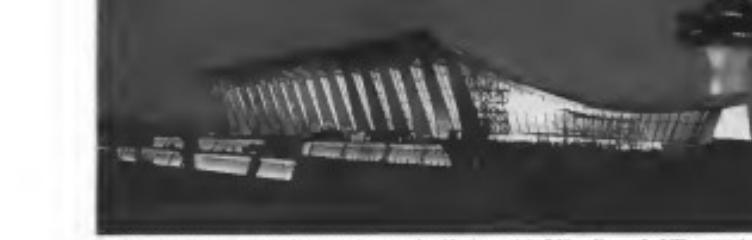
Withdrawal of scheduled service from one airport has usually resulted in the use of a much-needed general aviation airport, increasing non-airline passengers and federal support for such airports in terms of lengthening and expanding runways for aircraft related operations.

Industry observers believe CAB's proposal has few less opportunities than expansion from some consumers, probably because of the increased valuations of land around some airports, which could make it economically preferable to withdraw from the facility with a profit and participate with FAA in the construction of a new airport to be shared with a neighboring city. At the same time, they conclude that consolidation in small areas such as Dulles and Ft. Worth may be a separate CAB regional airport arrangement procedure, as was anticipated only by a local board order.

The Board's airport investigations were spurred by these circumstances: Northeast Airlines' financial problems, aggravated by the necessity of providing subsidized service to several non-metropolitan New England points, and recommendations from a group of New England state aviation officials that selected airports at 23 airports be abandoned, closed or consolidated into 23 other regional airports.

Generally, the CAB's investigations concern cities which are located within a 50-mile radius of each other. Major urban ground transportation links between city and airport would be limited to 1 hr. Other considerations, such as present facilities and overhead and transportation facilities, would enter into the selection of a regional airport.

CAB said that many municipalities may object to removal of regional service on grounds that they are able to meet CAB's "at least as good" policy for daily minimum passenger loadings. The Board said that this status can be transferred if it is endorsed that service may be provided as well, or better, by an adjacent airport.



NIGHT VIEW of Dulles terminal was taken from roof entry road used by airport officials. Public parking area for 5,100 cars occupies space to the immediate left of building. Alpha airlines will displace from mobile stages at main terminal level, down to a lower level by escalator for luggage pickup and downtown transportation. Dulles International Airport became operational Nov. 19.

First Scheduled Service at Dulles Begins

By Robert H. Cook

Washington-Dulles International Airport became officially operational Nov. 19 with 58 flights scheduled to be handled. President John F. Kennedy and former Presidents Dwight D. Eisenhower were to attend dedication ceremonies Nov. 17.

Eastern, Trans World, Delta, Braniff and Northwest Airlines are providing the first service into the \$10 million federal facility with 28 hangars and 23 aircraft engines. Eastern's 36 flights per day are more than half of the total. TWA has the next highest frequency with 22 flights.

American Airlines will commence Dulles service on Dec. 1 followed by Pan American World Airways on Jan. 6, and United Air Lines on Jan. 15. National Brushy Creek Airways Corp., Northeast, Allegheny, Lake Central and Piedmont Airlines are expected to commence Dulles schedules in the near future.

Although officially operational, Dulles is still in construction, dietary and medical facilities will be completed by March 1 of next year. FAA issued operating certificate Nov. 19.

Most of those remaining problems are considered minor and generally involve the completion of installation of rough mixed and automatic ramps within the terminal building, such as baggage claim ramp belts and major entrance doors. Work is still in progress behind highly-secured perimeter on some airside racket stations, concrete sheds and jetty support buildings.

Under the terms of its construction contract, the airport will demand liquidated damages ranging from \$300 to \$500 per day fines for deviation for each day's delay in reaching completion date. At

this rate, these FAA damage claims could total \$400,000, since the finishing contract on the terminal building alone called for a completion date of July 16, with assessment of liquidated damage at the rate of \$10,000 per day.

However, it is doubtful that FAA will fully implement the assessment clause, since more time extensions have been granted, and because those assessed would probably take the matter to court. It would seem that early in the day, the law has been unavoidable for the airport to be opened, given the size of the site.

The taxpayer was told it would take 10 years to build the airport two years ago. We looked at it, found the cost underestimated and set a new target of \$106 million with a new completion date of this fall. Now we've made it," he said.

Public demand for service will be the deciding factor in the ultimate expanse of service at Dulles and the volume to be retained at Friendship International Airport, in Bethesda, Md., he said.

By 1975 traffic growth in the Washington-Baltimore area will require the use of all three east coast airports—Dulles, Friendship and Washington National, as well as three or four private aviation fields, the FAA administrator predicted.

DFA has a large investment in Friendship; considers it a good, safe airport and wants it to "live," Halley said.

However, he said, Dulles' location close to the traffic population center of the area, as reflected by FAA studies, may cause a demand for more Dulles schedules. It might be "10 to 15 years, maybe as little as five" before Friendship could succeed in attracting some of its hubbed traffic, he said.

"The one thing I want to emphasize is that we're going to need all three airports over the long term," he said.

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CARGO LOADER DEVELOPED for USAF 461L is demonstrated in cargo hold of Lockheed C-141 at MacDill, Fla.

Air Cargo Standardization Program Urged

By James R. Atchek

Atkins—Airline urging to standardize their cargo operations cooperatively, in the interest of better service, also gets a helping hand in pushing the Air Transport Association's air cargo committee with its plans for standardizing cargo tracking systems.

The 461L Materials Handling System Safety Study (AW June 11, p. 54) is a strong influence since it is a study in scope of standardization in the vital area of cargo aircraft design, policies and ground handling techniques.

However, 460 delegates to the International Forum on Air Cargo here recently were cautioned against adopting 461L standards strictly on the interest of minimizing wide military cargo differences.

Bog. Gen. James G. Sherrill, commander of 106th Air Transport Wing of MATS, said the Lockheed C-141 and C-141 transports will enable MATS to carry much of the volume now concentrated in conventional carriers. In the final year just ended, MATS increased to \$185,000,000 in passenger, cargo and mail, or about 30% of the military worldwide traffic.

"While we can expect demands for military air to continue on the upswing, I think we need the sensible measure that part of the slack between

demand and supply will be taken up by MATS increasing capability," Gen. Sherrill said.

For this reason, although we will always have the unique needs of the commercial airlines in our logistics operations, it appears to everyone that the growth of the commercial air cargo industry should not and cannot depend entirely upon military requirements," he added.

Airline officials attending the forum, which was sponsored jointly by the Institute of Aerospace Sciences and the Society of Aerospace Engineers and 461L, was an acceptable standardization pattern because it has forced the transition of shipments between air and surface modes.

The cost savings alone will contribute to the financial cost of the new air cargo system," said Eason F. Johnson, president of Air Cargo, Inc.

"We must adapt our system to work with trucks, either from land or sea, change to meet our needs."

The 461L cargo pallet measures 88 x 105 in., and agreement was general that the 95-in. dimension should be adopted as standard, joint if conditions in truck bed width.

Several tracking representatives queried the 95-in. width, saying that only

51% of the trade in the U.S. and fewer in Europe are wide enough to take 95-in. pallets, and that trucks are usually wider than pallets with 88-in. width. An airline cargo official reflected that "if we could cut 20% of the trucks in this country to work supporting an 88-in. width, we'd be selling in profits."

William Leflerich, vice president of equipment research for American Air Lines, said standardization was already partially under way among air cargo nations. Buying 130C freighters ordered by American and Pan American, and 461L, was an acceptable standardization pattern because it has forced the transition of shipments between air and surface modes.

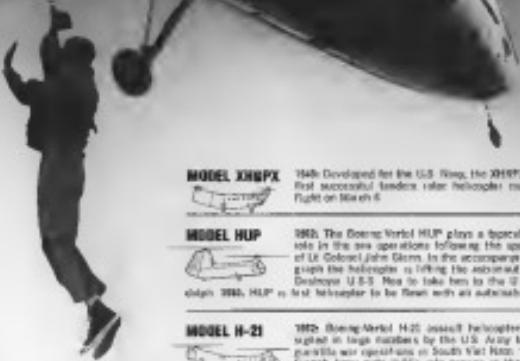
The 130C cargo plane will contribute to the financial cost of the new air cargo system," said Eason F. Johnson, president of Air Cargo, Inc.

"The 88-in. pallet is standard, in most cases at present. Besides the 88 x 105-in. 461L pallet, there is one measuring 85 x 118 in. for the CL-44. On the 130C American will use only the 461L pallet, but this other aircraft carrying 88 x 105 in. and 88 x 125 in. AW Oct. 29, p. 45)

88-in. to be resolved are variations in aircraft size, terminal facilities, ground handling equipment and the legal yard of material aid tape for intermodal

MISSIONS & MILESTONES

THE HISTORY OF THE
BOEING-VERTOL
TANDEM ROTOR "FAMILY"



MODEL XH9PX



With a payload for the U.S. Army, the XH9PX, world's first successful tandem rotor helicopter makes first flight on March 6.

MODEL HUP



1952: The Boeing Vertol HUP plays a temporary role in the air operations following the space flight of Lt. Col. John Glenn. In the accompanying photograph the helicopter is lifting the astronaut from the Douglas U-3B. He is to take him to the U.S. Navy ship USS *Antietam* to be flown with an automatic pilot.

MODEL H-21



1952: Boeing-Vertol H-21 assault helicopters are assigned to large squadrons by the U.S. Army to conduct guerrilla war operations in South Vietnam. 1956: The French Army parts H-21s into service in the Algiers conflict. (This was the first time a helicopter had introduced these aircraft into combat operations.) Data used in developing its predecessors and refinements in later helicopter models.

MODEL 107



1956: Passengers aircrew configuration of the 107 is corroborated by the FAI. Arrived in New York Airports 1956: Military version of the 107 was U.S. Navy configuration for a marine transport helicopter.

MODEL HC-1B CHINOOK



1956: The HC-1B Chinook, America's most powerful helicopter, is in large scale production and flying. It attains speeds over 150 mph with higher than normal maximum loads. 1961: First Chinook completed and ready for ground tests. 1966: Vertol Division gets go-ahead to develop a non-23-ton capacity transport helicopter for the U.S. Army.

VERTOL BY BOEING
VERTOL DIVISION



SPRING LOADED ROLL BEARING rollers on the Douglas DC-9 facilitate easy movement of pallets. Maintenance is compatible with the military MIL-C system.

agents. "Standardization will reduce costs," Lefebvre said, making a financial sense for it among cargo operators. "But will take a lot of arguments, and some hard work," he added.

Lefebvre said carriers must cooperate more in deciding what type of aircraft best suits a particular standardization, than have the manufacturers do it. He said the only reason the Douglas DC-87 and Boeing 727C have identical floor widths is because the airline partly determined the dimensions when the passenger versions of those planes were being designed.

"The next generation of cargo aircraft should be designed toward standardization," Lefebvre said.

Example of the need for uniformity among aircraft, Lefebvre said, is the CL-44's inability to take pallets loaded as high as those that can be loaded in the DC-8 or DC-9. The Lockheed L-100, a civilian version of the C-141 (AW Oct. 29, p. 44) will be able to take longer containers, because of an air binding feature, than those that can go into the side doors of the Douglas and Boeing freighters.

Concerning decreasing progress in standardization at the meeting, he determined that aircraft represent the greatest advancement in date. Some steps have been taken toward standard and packaging of cargo for shipment. In administration, in paperwork, uniformity is practically nil.

"The meeting should have been held two years ago," said R. F. Staus, chief executive development engineer for Lockheed-Georgia Co., and general manager of the division. "The concern is, our standards aren't good enough to implement them at this time."

Staus said it is doubtful whether one acceptable standardization for cargo operations, and in aerospace companies, will exist before 1970. To get it even that early, work must begin

New York, constituted by the Society of Automotive Engineers. Standard and airline representatives will be invited as well as officials of U.S. and international standards bureaus.

"We also want this to come in the attention of the International Air Transport Assn., to initiate a program for standards among IATA members."

Slick, Surface Movers Discuss Cargo Service

Dallas, Tex.—Slick Airlines held its first meeting here last week with executives of six major surface freight carriers to discuss details of a new rail-to-truck cargo service based on economy rates now before the Civil Aeronautics Board (AW Oct. 1, p. 52).

Cooperative air/rail/track program would provide joint through carrier services 1,500 to 2,000 points in California, Oklahoma, Texas, Indiana, Ohio, New York, New Jersey, Connecticut, Atlanta, and Louisiana. Governmental source would handle a single package, single responsibility, and a tremendous saving system.

Rates of \$1.75 per hundred-weight between Columbus, Tenn., and New York City, and \$15.12 per hundred-weight between Sacramento, Calif., and Bradenton, Fla., are examples of the proposed freight rates.

Joint program calls for guaranteed functioning delivery for instantaneous shipments. Service from Dallas to intermediate points would provide road-to-airline delivery, Slick Corp. President and Board Chairman W. R. Staudt said.

"I don't think ever get more than 1%," he added. "But if we do gain 1% of the market, we'll improve more in many airports for freight agents at no cost to the railroads or shippers."

Also, S. Bond, director of the Civil Aeronautics Board, endorsed the air/rail/track efforts in a speech to the forum delegates.

"Cargo is not a stepchild in our philosophy and strategy," Bond said. "We are working to develop less burdensome tariff filing procedures. We are exploring the great possibilities of great air/rail/track movements, trying to bridge the regulatory gap between the Board and the Interstate Commerce Commission."

Bond said the CAB is also trying to develop a suggested rate philosophy for cargo, which is a grand toward a fair return for the railroads.

"Let me emphasize that we are not looking to force one carrier into any particular rate-setting philosophy," he said. "We are trying to find a strong point in the hope that everyone will reach agreement on where the nose is to begin."

Next move in the cargo standardization program is a February meeting in



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California and the Pacific Northwest...Minneapolis/St. Paul. They're your fastest flights between San Francisco and Denver...the fastest, fastest service ever from San Francisco or Los Angeles to Minneapolis/St. Paul...and they bring you to Phoenix in no time at all.

No wonder Western's Fan/Jets are the talk of the sky!

WESTERN AIRLINES



FINNAIR MARY B CARAVELLE is seen at Helsinki Airport. Note of another Caravelle is visible at the extreme right. Photo by Jim Mark 3-Caravels

Finnair May Trade in Caravelle 3s To Finance Horizon 10B Purchase

Helsinki—Finnair-Aero O/Y, the Finland national airline, may finance the purchase of six Caravelle 10Bs—powered by Pratt & Whitney JT3D-1 turbofan engines—in trading its six old Mark 3 Caravels.

Reported deal would mark the first sale of aircraft in Finland by Caravelle 10B. Even more important, the old-Finnair contract would be a precedent-making example of new jet aircraft being financed on pure hire, and in used jet transports.

Airline sources here say Finnair would take delivery on its first Caravelle Horizon in March. Delivery of the first five aircraft reportedly would be spaced at about intervals so that Finnair could operate three Caravelle Horizons in the 1964 season. Delivery of the last aircraft, however, might not take place until 1966.

Connected with the old-Finnair talk is the possibility that KLM Air Transport will buy the six old Mark 3s, which fly between Western Europe as well as securing a domestic service in Finland now, come the deal by switching to single Caravelle Horizon 10B. Then, the total Finnish order would be seven jet craft.

Finnair also has been studying the British BMC 111 retrofitted, and the smaller twin-jet may represent an alternate equipment plan for the future.

The agreement involving joint participation in used jets is to bring both to negotiate, and bidirectional blades could quick the process. The French are free, for example, initially, to conduct a auction by taking over the Finnair-Mark 3 Caravelles, and vice versa if there's been enough off.

More reason for Finnair's attempt to negotiate a trade-in is lack of capital to finance the entire cost of the new equipment. The Caravelle Horizon 10B costs \$56 million, compared with

an initial price of about \$3 million for the Mark 3 Caravelle.

Thus far, Finnair officials would have to concern itself with disposing of its six old Caravels once it bought the new. Purpose of the present agreement is to have a full take-over of financial risk of finding buyers for Finnair's used Caravels. Trade-in price is believed close to the original figure paid by Finnair to the manufacturer.

For its part, Finnair has agreed to reschedule its Caravelle major contractual deliveries in order to permit latest modifications to the aircraft. In that way, the used Finnair Caravels will be up-to-date, as far as modifications are concerned, when Sea Airlines takes them back.

Finair's present fleet consists of four Caravels, all Mark 3s, two Conair 10Bs and six Douglas DC-8s (IAW Jan. 21, 1962, p. 60). Delivery of Finnair's last Caravelle took place last February.

Finnair's entire international route system consists of a daily Convair 880 flight from Helsinki to Paris via Hamburg and Amsterdam. The carrier also operates Caravelles from Helsinki to London via Copenhagen, Stockholm, four times weekly, and twice weekly Caravelle service between Helsinki and Moscow.

Modernization of Convair 880s is under way, involving Copenhagen, Stockholm and Frankfurt. In winter months, when traffic slumps to Moscow, the carrier often replaces its Convair flight with a Convair 440.

Expected purchase of the new Caravelles probably means Finnair, after some time, will drop its 880s, it is reported that Finnair will try to extend its route toward such ports as Rome, Madrid or Barcelona. New equipment also could mean increased Finnair interest in charter activity, both on its

own operations and in acting as a charter carrier.

At present, for example, Finnair charter a Convair 880 to Lufthansa. After a Finnair Convair arrives at Paris from Helsinki on its daily run, it makes a roundtrip flight to Frankfurt for Lufthansa. Return flight comes by the reverse, although the other way is from Lufthansa. Once returned to Paris, the Finnish Convair then makes an return flight back to Helsinki.

The arrangement has helped to push Finnair's Convair utilization rate to about 70% to date. The carrier's four Convairs handle about 75% of Finnair's international traffic.

Present, although 75% government-owned, operates with some of a profit goal still pricing motivation. The airline receives no subsidy from the Finnish government. Finnair's basic operating philosophy, as explained by carrier officials, is that the airline ought to meet the airline needs of Finland.

Sense of independence has always led Finnair officials to turn down offers to enter into the Scandinavian Airlines System (SAS) organization. However, it now appears SAS has a pooling arrangement in flight between Helsinki and Stockholm partly. SAS also gives major overhaul of Rolls Royce engines used on Finnair Convairs.

New Argosy Version

Louisville-Westover Glister Aircraft, builders of the Kolb-Everett Dart-powered and Argus 650 transport, is negotiating with several U.S. carriers for a second passenger-cargo version holding 46 passengers and 14,000 lb. freight.

Roy E. Lohengrin, general sales manager, said current design studies have worked out a fuel economy of about 4.5 crds on available ten miles per cargo, and 2.17 crds on available ten miles for passengers. Company turned to the used configuration design when it learned that Eastern Air Lines was considering ordering a second Dart-powered aircraft and All-Nippon Airways and Aloha Airlines were exploring a similar plan involving Convair 440s.

Westover-Glister Argus version, the 200 series which includes the sea spin-wing for full lift-off speed, features a full cabin-with-living door at the front of the fuselage in pressurized landing of outcome cargo up to 5 ft. 4 in., with 8 ft. 6 in. high and 20 ft. 1 in. long. Passenger doors are at the rear, and compartment is completely separated by a movable bulkhead to allow loading flexibility.

Sixty 200 Argus now is in production for Air Fox Transport Co. Inc. Unless XAF orders further more than the 50 now scheduled, production will phase out by next summer.

CENTRAL AFRICAN AIRWAYS *chooses BAC ONE-ELEVEN*



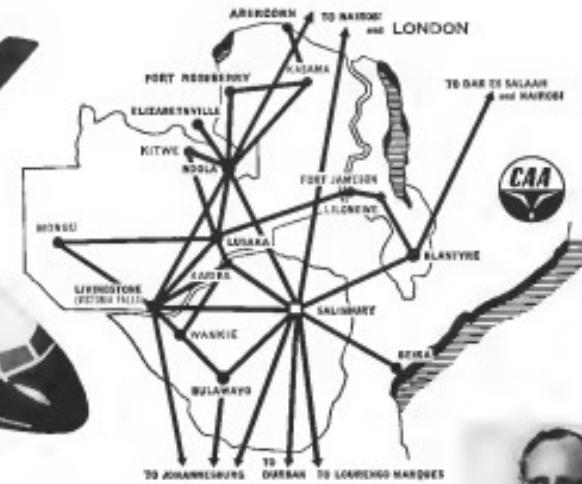
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Mr. W. Sherriff-Shaw,
Chief Executive and General Manager, Central African Airways
B.A.C.

C. A. A.'s selection of the BAC One-Eleven for its short-haul medium-haul intercity services will link its routes between the frontiers of Central, East and South Africa. It will also make daily short-haul services available—faster and at a considerably lower cost for the service, tanked operating at comparatively high altitudes and high temperatures and into airports not yet designed to take a long-haul jet aircraft.

C. A. A.'s need was clear: for an aircraft which could provide a standard of passenger service—in speed, comfort, quietness and ease of flight—and ground handling which would enable C. A. A. to hold its own with long-haul jet operators over the Commonwealth's regional routes.

It is confident that in the BAC One-Eleven C. A. A. will have a jet airplane that the public, pilots, ground staff and airline controllers will like.



AIRLINE OBSERVER

► Passengers against the recent proposal by United Air Lines' President W. A. Patterson for a one-class transatlantic service (AWW Oct 15 p. 45) we wonder that the domestic transatlantic industry is still so long distance from finding a pricing formula that will be acceptable to all airlines. While spread of fares across airfares on routes and basis within the industry has found the voluntary acceptance of some passenger fares and caused others to be dropped. The single-class fare proposal undoubtedly will stir a flurry of counter proposals, none of which is expected to win unanimous industry support.

► Last leg order for the BAC 111 freighter transport now comes from American Airlines. American has drawn up specification for the version it wants. If the order is placed, it will call for at least 25 aircraft. Meanwhile, several local service carriers are showing active interest in the airplane. Bausell Airways is expected to receive its first order for six, plus an option for six.

► KLM and Sabena have recently signed a bilateral air transport agreement giving Aeroflot rights to its Moscow-Rotterdam-Sabena-Helsingborg-Dubai route. Sabena is the south African carrier with which KLM has signed an air transport pact. Aeroflot sees the Moscow-Rotterdam route as a valuable South African's total international route network to over 62,000 m.

► Trans World Airlines' supersonic planes, held by the carrier's finance department as "leases" that funds will be available, are preparing a new evaluation of TWA's trailing freighter requirements. Canada CL-44 is included in the study package, but airline officials have yet to receive competitive bids from Boeing 727C freighter all-cargo transports ordered by Pan American World Airways and American Airlines.

► First de Havilland Trident 3 being readied to leave the hangar gives the present leading gear rutting due to binding forces on the slats. A layer is being added to the uppermost part to reduce impacts, and will be included in all future production models. In addition, de Havilland has discovered that the inboard wing fairing, installed on the Trident as a protection measure, is not needed. It will be removed, resulting in a reduction of drag.

► Lockheed Aircraft Corp., accelerating its effort to break back into the commercial field, is presenting research and development toward a supersonic transport and a practical VTOL aircraft; the two types of aircraft Lockheed feels will be the primary tools of the airline industry.

► Douglas has started an Military Air Transport Service earlier about need for a long range transport on the Douglas C-133 class. Some potential users are again bidding on the project if it develops, under the order probably would be for a small number and such a special mission aircraft would have no commercial application.

► Feasibility of developing a bilateral air transport agreement with Red China is still being studied by Japanese government. Japan's foreign minister recently stated that the time is not yet ripe for a conclusion of an agreement covering air services between Tokyo and Peking. It is known, however, that a number of Japanese airline officials are anxious to begin such a service, but are deterred primarily by a government fear of straining U.S.-Japan relations. Possible loophole in Japanese attitude toward expanding trade with Red China protected trade program will be justified on grounds that economics and politics are separable.

► Financial problems and regional differences on cargo engagement needs have stalled British Overseas Air Corp. plans to order CL-44 freighters. BOAC officials term the order "dormant," not dead. Scouring nation BOAC had the delay may result eventually in an order for pure cargo. BOAC is also to Victoria about air-freight potential of the VC-10. Lufthansa also is reconsidering its interest in the CL-44 (AWW July 23, p. 74).

SHORTLINES

► British Airlines has expanded its all-cargo service from New York and Boston, Shreveport, Mobile, Tampa and Basin to three weekly round trips with Douglas DC-9F all-cargo transports.

► American Airlines has repossessed a Ford Tri-Motor aircraft operated by a passenger charterer. This decade ago was the first aircraft to be used by American, or, used with separate engine, ship private a regular and more economical revenue than can be obtained with any combination of separate lifting and propulsive engines.

► British Overseas Airways Corp. has inaugurated a third weekly freighter service between New York and London using a Douglas DC-7 transport.

► Civil Aviation Board has postponed procedure steps in the U.S. Civil Aviation Board Aviation Route Case as complaints to separate by a number of participating airlines.

► International Air Transport Assn. technical committee will meet in Bangkok Nov. 25-29 in a regular session, but attention will be focused on recognition, communications and operational problems in the Bangkok area which, it is felt, must be faced before a major hub of airline services in the southeast Asia sector.

► Northeast Airlines, in a last challenge to Eastern Air Lines' New York-Los Angeles CAB route, is requesting a reroute around Boston at five cents per mile. Fare would be \$110 between Boston and New York and \$12 between New York and Washington, compared with Eastern's rates of \$114 and \$16 respectively. The rate would apply to tickets sold on a standby basis.

► Quantas Empire Airlines has reported a profit of \$920,835 for the year ended May 31, a slight increase over the net profit earned in the same period last year. Conserving profits was attributed by the carrier to reduced costs, which were said to be among the lowest in the industry.

► Swissair has begun its winter transatlantic schedule with eight weekly round trips out of New York and two weekly round trips out of Chicago and Montreal.

► Trans World Airlines has reported a 9.6% increase in revenue passenger miles in October compared with the same period last year. Cargo ton miles increased 24.4% in the same period.

Simplified Power for V/STOL Aircraft

Bristol Siddeley Infinitely Variable are the optimum power source for all V/STOL applications, because the total thrust can be used for both lift and forward propulsion. They provide the maximum thrust with minimum weight, or, used with separate engines, ship private a simpler and more economical solution than can be obtained with any combination of separate lifting and propulsive engines.

NOVEL ENGINE INSTALLATION

- Simplified installation.
- Simplified overall control.
- The resultant thrust and nozzle drag

passes through a fixed point near the aircraft center of gravity.

► Maintenance and spare requirements are confined to one engine.

► Availability of a large power reserve for acceleration and maneuvering.

MULTI-ENGINE INSTALLATION

- Three specified lift engines required to attain total propulsive power is also available for take off.

SUPERDRIVE FAN

In Bristol Siddeley M3/M4/M5 variable fans can be turned in the 0°-90° direction or 180° counter-clockwise to give a thrust vector for

take off and approach flight. This provides chamber turning greater...

► A large thrust vector for supersonic speeds is obtained in a smaller diameter in specific flight configurations.

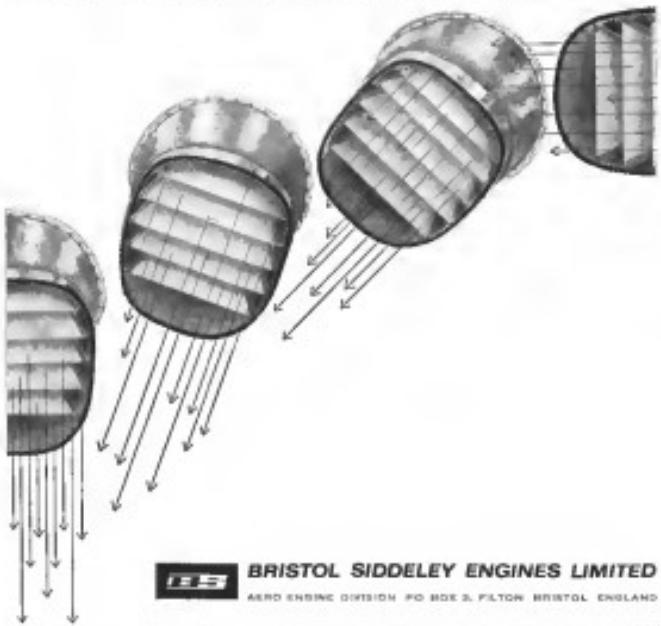
► Engine performance matched to aircraft cruise requirements.

► Quicker climb for transonic altitude.

► Quicker rates of operation.

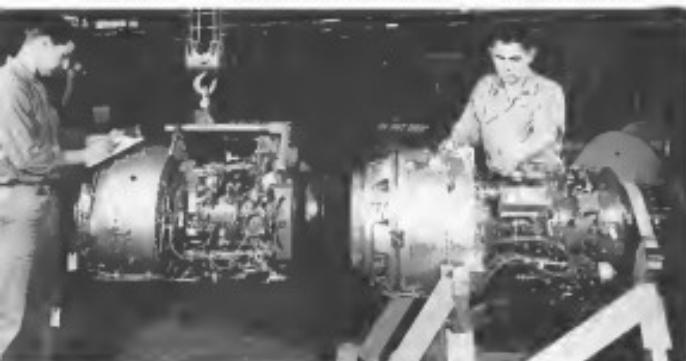
The Superdrive fan system can offer more than 10% reduction in aircraft cruise power.

The development of Bristol Siddeley 1600 Series engine is supported by the UK Government through the Marconi-Wrightson Development Programme.



BRISTOL SIDDELEY ENGINES LIMITED
AERO ENGINE DIVISION PO BOX 3, FILTON, BRISTOL, ENGLAND

AERONAUTICAL ENGINEERING



MAJOR LYCOMING PRODUCT LINE consists of T53 and T55 gas turbine engines, typified by the T55-L-5 (left) and T55-L-4 (right). First of the T53 series to enter service, the T-4 model at 600 shp., T55 series entered service at 2,100 shp./hr. dph.

Lycoming Plans to Develop Family of Gas



PRODUCTION LINE FOR T55 turboshaft engines is shown from overhead, above left. Right: Vertical test stand with operating T55 is used to check characteristics of propellent through typical VTOL operations. Wing can be pivoted during engine run.



AVIATION WEEK and SPACE TECHNOLOGY, November 19, 1962



PRODUCTION STANDS FOR T55 ENGINES are shown at Stratford, Conn. Production rate of T55 will soon be increased by about two and stratford hours and production rate of T55-L-5 engine also is reported to increase.

Turbines for Aircraft, Industrial Uses

By David A. Ardente

Stratford, Conn.—Lycoming Division of Avco Corp. is developing an T55/T55 gas turbine series to increased ratings and expanded applications largely carrying a future price tag of \$15 per horsepower.

The division plans to stay with the "small" gas turbines, which range up to either 5,000 hp. or 18,000 lb.-hr. thrust and to develop in that range a family of engines for civil and military aircraft, industrial and marine powerplants.

Based on the development program in the current series of T53 and T55 turboshaft engines, however, such a large quantity of work at helicopter powerplants. Future engines will include turboshafts, ramjetprop and turboshaft types, will deliver horsepower approaching the 4,000 mark, and thrust loads near 5,000 lb. With this improved performance still some reduced specific fuel consumption and improved power weight ratios.

Current Plans

Most of Lycoming's current production of gas-turbine engines is in the T53 series, with the T53-L-7 and T53-L-9 the major items. Production of these ratings, already high, is expected to increase by two and additional tones soon so that the low rate be-

turning out several engines per working day. Fired on this will be the switching load of the T55-L-5 engine now in moderate production.

Locating half a large portion of its reputation on piston engines, and they still account for a good portion of the corporate revenue. But developments in the piston engine have leveled out, and today's engine represents just about the last of the standard piston powerplants. Consequently, there is not much future market and development room at present in the piston engine.

But that hasn't stopped the engine division from trying to find a greater percentage of Wright engine business. Last year, Wright engine's market share was 100% in the Army Bell UH-1A helicopters and 100% in the Army's CH-47 Chinook. This was produced for the lowest cost achieved in the entire production program for these engines, which were built in several locations including the Wright plant.

This kind of expansion, plus the performance of its current crop of gas-turbine engines, gives Lycoming engineers the basis for their prediction of future power for the next decade.

They point to their experience in the T53 contract as one specific example. In T53 contract alone specific consumption is 6.75 lb./hr./lb.

An engine was built at a fixed price contract for \$2.2 million, and it was probably the first engine to be financed that way in this country. Along the route the requirements were changed. The engine had to be qualified in a 150 hr. test, not a 50 hr. limit. Its power was increased from 1,976 to 2,280 shp. fat taken. It had shifted in a geared engine, and was to be changed to an ungeared, high-speed shaft drive engine. An engine of rotation had to be developed.

Letterman Funds

At the end of the 150-hr. qualification test, there was money left over which was returned to the government. Since that, the division has offered several other programs on a comparable basis with a fixed-price bid. Seven engines are now on contract with the division: **T55-LA**, **LB**, and **LC**, powerplants for the Army's Bell UH-1A helicopters and the USAF's Kaman H-43B helicopters. In the Army's CH-47, engines, the three turbines available in 600 hr. for the USAF's 1B engines, that run at 600 hr. Engine has a without power rating of 182 shp., and a maximum thrust of 182 lb. In an equivalent shaft horsepower of 900. Equivalent specific fuel consumption is 6.75 lb./hr./lb.

T55-LA, powerplant for the Army's



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Each U.S. Navy and Marine Corps aircraft is regularly updated and maintained in readiness by periodic induction into an Overhaul and Repair Department. Timely performance of the "O&R" mission presents fantastic scheduling and parts control problems.



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specific engines have been run more than 675 hr after a major overhaul without showing need for another tear down.

Beyond these sums are 11 advanced engine developments of both the T53 and the T55, which are, in varying degrees, available. Computer development has been done for several (see box) and others have been run on the test stand. The primary objective now is to get orders for them.

Most interesting of the T55 developments is the use of the LTCMG-7 (longitudinal combustion) at 4,575 shp. This engine has been running for about one year now, using a split power generation to distribute the loads on the gears and improve the life of gears. In principle, the torque is fed from the longitudinal engine shaft in a first stage of gears which transmit about one-third of the input power directly to the propeller shaft before it even goes to the second stage of gearing. This reduces the loads on the second stage, so that the gearbox can then take off weight for gear life. This long-term development of parametric and gearbox has been applied for all the new T55s now in production.

VTOL Test Stand

Loring has had a continuing program of testing engines in vertical VTOL operation using a special test stand which can rotate the running engine through a range of positions corresponding to those expected in VTOL aircraft.

With started with a T55-13 engine mounted in a complete aircraft or

a tail drag aircraft. The wing section was pivoted on the test stand so that it could be swaying through the angles experienced from vertical takeoff to horizontal flight. The engine was somewhat modified to handle the different mechanical techniques the main bearings were sealed with performance seals, and a scavenging pump was added to the accessory gear box to service No. 3 and 4 bearings.

Against the initial problems with the initial operation of the engine on many different attitudes, the engine reacted. Bearing temperatures were normal, there was no apparent increase in heat rejection to the oil. There was difficulty in starting the engine in a nose-up position or in intermediate attitudes between vertical and horizontal.

Engineering looks to the future and industry market in a major future source of income and revenue. One major drive in the program between the divisions will be doing one-third of the 1965-1966 business in this area.

Potential market is presently Navy amphibious vehicles, and Loring sees the possibility of sizable sales beginning in about two years for engines for VTOL aircraft.

One factor in that the number of postscripting for the market will equal the number of high cycle engines sold during the same time period.

The division is competing with both Solet and Pratt & Whitney, whose old twin to the reheatable gas turbine turbines. Both have solid numbers of these units for power ratings.

Testing intends to work in the horizontal stage between 1,000 and

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SELECTOR SWITCHES for

- ↳ Resistance Thermometers
- ↳ Thermocouple Thermometers

THERMOCOUPLE SWITCHES



Switched
Series
3 leads
4 leads

Engineered to give years of service in test work as well as in production. Lewis makes these heavy, long-lasting contacts, positive detection action and sturdy terminals for easy wiring.

The case is replaceable and dust tight of class fifteen (absolute Herk). Block-diaphragm adjustment knobs are used to keep the contacts clean and supporting the retaining bushes.

RESISTANCE BULL'S-EYE SWITCHES

A unique use of the same construction except that they are fitted with a unique terminal set for three-wire high resistance.

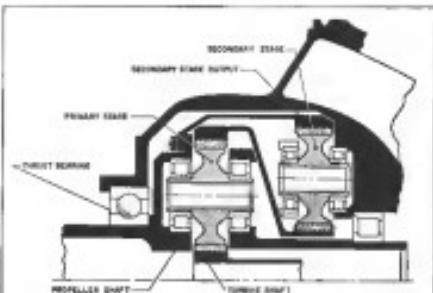
THE 98 SERIES THE BULL'S-EYE RESISTANCE

THE ADJUSTABLE BULL'S-EYE

Stainless steel, sheathed resistors 1% tolerance 15% greater in diameter, 2.032 inches total shaft length, 0.600 bore diameter, 0.525 NPSA threaded bush. 1/2" dia. dia. Dia. Designed especially for connecting two or more resistance temperature detectors to one circuit, now being in the market job.

Write for our descriptive bulletin on Selector switches.

THE LEWIS ENGINEERING CO.
Specialists in Temperature Measurement
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CROSS-SECTION through Lycoming split-gear propeller reduction gear shows the layout of the different approach to gathering power. Primary shaft drives primary stage reduction gearbox, which in turn drives a secondary stage reduction ring. Output from the secondary stage drives the propeller shaft through a large pin gear bolted to the shaft.

SHUT DOWN IS A PEOPLE BUSINESS

Multi-space travel is a business discipline. At the same time, all types of space vehicles and equipment, "explosives and all," in military and commercial use, if there is no maintenance to keep them in top condition, they will not be successfully flying nor will their crews be successful. The problem is, in general, the growth of people is considerably accelerated. The problem is, in general, the problem is, people are not as good as machines. People are not as good as machines. People are not as good as machines. People are not as good as machines.

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ADVISORY DIVISION,
P.O. Box 2000,
Los Angeles 23, California

An investment in your company.



LYCOMING T53 ENGINES are assembled on this mobile base before being run and accepted. Rotatable holding fixtures are used for convenience.

T53, with a possible stretch at high altitude to 1,720 hp. It is being used as the powerplant for a vehicle recuperator with the LTVF, the Rog-Werner LTVF, built around the planning hall concept.

Recycling work in the industrial field started about 15 months ago with an adaptation of the T53, and then the work was expanded to include the T53 engine. There are now front end and rear end casting, the former conforming to the old and status. The industrial engines are designed around switchable capability and are currently running on Diesel fuel.

Lycoming has two current orders of rotary turbines:

- **TF-1460**, a marine version of the T53, rated at 1,220 hp. It weighs 1,208 lbs., complete with accessories and gear box. It is currently the powerplant in the Lycoming LTVF, a leading low-suspension vehicle using a hydrostatic system.
- **TF-385**, a marine version of the

T53, rated at 1,720 hp. It is being used as the powerplant for a vehicle recuperator with the LTVF, the Rog-Werner LTVF, built around the planning hall concept.

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- **TF-385**, a marine version of the

Advanced T55 Engine Series

Lycoming Model	T55-A	T55-A-1	T55-C	T55-C-2	P53R-1	L700A-1
Type of application	Helicopter	Helicopter	Teardown	Helicopter	Teardown	Teardown
Takesoff shaft hp	3,000*	3,400	3,440	3,400	4,000	3,650
Max. thrust lb	200**	240	235†	200	220	220
Gross shaft rpm	16,000	14,600	13,370	16,000	14,000	13,600
Gross weight lb	370	370	375	370	380	400
Reserve	Ground	Ground	Airborne	Airborne	N/A	N/A
	720	730	780	780	800	800

* Military rating. **Not yet available.

† Received from



Navy Launches Q-2C

First launch of a RIM-8 HARM Q-2C by Navy personnel at Pt. Mugu, Calif., is shown. Standby is from 11,000 ft. to about 10,000 ft. Max. altitude is about 44,000 ft.

aircraft. Their entry bodies were developed by Avco's Research and Advanced Development Division. One indicator of the volume of work involved is the dollar value of the contract for the MA 11 body. Value is \$19,500,000.

Maintenance Work

In addition, licensing is manufacturing second-stage rocket motor drivers for the Minuteman for delivery by August. General. These chambers are being built from both steel and titanium, but indications are that the titanium will be discontinued at some point in future production. Work involves production of the cylindrical outer section, and both upper and lower circular apertures.

However, the work does not conclude.

At one time, Lycoming was producing

cameras for all three stages of the Minuteman, plus the MR 3 reentry vehicle. It has now phased out some of that work, including the production of second stage casing for the Polaris missile and work on the Nike-Hercules and the Tacon.

Rocket Motor Chambers

Now on the shop floor, in addition to Minuteman production, are solid rocket chambers for the second stage of the X-20 Dyna-Soar. These are not too different from a compressed Minuteman second stage casing. The diameter is also building size and center hole sections for the Martin Ills probe nozzle.

Lycoming is also a subcontractor to Wright Aerautical Division on the first stage. Minuteman probe casing, comprising complex, disassembled chambers go to the contractor. Also in production are spherical rocket motor chambers being built for Twinstar. The coolant nozzle chambers eventually will be used in the Starfire space vehicle.

Large portion of this type of work is done with hand, or three-dimensional drafting machines controlled by punched tape. IBM card, or terminal. Estimated total cost of these operations at the Starfire plant, probably, the largest group of them conducted in the United States.

Lycoming has also won a subcontract as a developer of literature publications. Our current contract recently renewed from Associate Systems Division of Air Force Systems Command, calls for the development of some 4-ft.-dia, 10-ft.-long cylinders made of high-strength steel, open in the middle to receive insulation.

These enter are the same size as those for the second stage of the Minuteman ICBM.



Hercules Shows STOL Capability

Modified Lockheed C-130B Hercules transport demonstrates its short-field capability by taking off from rough field-type obstacles. Modifications include increased flap spreading rate and deflection, increased cabin and aero ducts, and addition of a drag parachute in case of under-the-rudder.

NEW CONCEPTS IN HIGH PERFORMANCE HELICOPTER DESIGN Pacific Dynamics' new and revolutionary design features the ability to fly faster, higher, longer and more safely than any other helicopter. Pacific's new techniques make it possible to get helicopters unbreakable safety margins.

1.1. Helicopters with a super-long-range, constant-speed cruise rate at greater than 100 mph.

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141.1. Helicopters with a super-long-range, constant-speed cruise rate at greater than 100 mph.

142.1. Helicopters with a super-long-range, constant-speed cruise rate at greater than 100 mph.

143.1. Helicopters with a super-long-range



ON WATCH:

The Navy's anti-submarine warfare task is no longer confined to protecting our ships from enemy raiders. Now our cities—even those far inland—face potential danger from sub-launched nuclear missiles. Helping the Navy maintain alert watch over America's more than 14,000 miles of coastline—as well as the vital na-

tional lines of the world—is the Lockheed P-3 Orion. The big 400-knot Orion is the deadliest combination of man, electronics, and armament ever pitted against a submarine.

The P-3 Orion is just one way Lockheed is working to help the Navy in its fantastically complex job of detecting, locating, and tracking hostile submarines.

the Navy's new P-3 roams vast reaches of the sea to keep hostile subs at bay

Six of Lockheed's divisions are deeply immersed in ASW and related phases of oceanography. Lockheed researchers are probing subjects like underwater sound propagation and scattering; temperature gradient effects; sound transmission through the interface of the ocean and the atmosphere; and sea-bottom

effects on sound transmission. They even record and analyze the sounds made by undersea creatures.

Lockheed's Anti-Submarine Warfare and Ocean Systems group coordinates a corporation-wide effort that runs broad and deep—from the depths to the surface to the stratosphere above.



Final Balzac Testing Scheduled for April Completion

First Boeing transonic flight from vertical should be transonic flight will begin in February. Complete testing of five-phase flight will be completed by April. Aircraft strength compared to initial five-flight test plane (AW Nov 13, p. 39) and new will be grounded for about a month while temporary gear shims in these photos will be replaced by normal retaining gear so that conventional lights can operate. During five-flight VDTL test, Balzac lifted off at pod a g-force per pt. 100 to an altitude of 150,000 ft. and landed in that position. Handling performance of the aircraft improved smoothly and deliberately to ground observers. Five

flight was made Nov. 6 at Malina Villandry near Paris. Aircraft was piloted by Deonish's test pilot René Legendre. Note lowered down on left of Balzac is top photo for RB116 engine which powers the aircraft (AW July 14, p. 29). At speed maximum, the spring-loaded covers are closed and, after transition, is employed, the covers are closed to a bulk position. Balzac during the transonic propulsion system in the Balzac is diverted by an S-shaped pipe into the fan duct to permit portioning of the lift engine jet air of the air in the intake ducts. Test pressure in bottom photo are given as 8-constant systems.



NASA Stresses Conventional Alloy Use for Supersonic Transport Skin

By Dennis E. Frink

New York—Heat and stress factors imposed on the skin of the proposed U.S. supersonic transport will have to be met with conventional alloys, insisting requirements of some exotic metals cannot be met on the proposed time schedule.

This was the opinion George C. Deonish, National Aeronautics and Space Administration's Office of Advanced Research and Technology, expressed at the National Metal Congress here recently.

Deonish based his remarks on findings of NASA's Special Committee on Materials for the Supersonic Transport—part of NASA, the Federal Aviation Agency and the Defense Dept.—which he proposed a development schedule calling for first flights by mid-1967.

Deonish based his basic design concepts which will affect selection of specific alloys.

*Supersonic transport will have a skin area of 15,000 to 20,000 sq ft, depending on the design (AW Jan. 7, p. 21).

*It will be subjected to temperatures ranging from 60°F in the nose section up to 2,000°F near the engine exhausts with such as 15% of the surface at the highest temperature rates in some designs.

*Aircraft temperature levels expected during the initial and final phases of flight may reach as low as -60°F at 70,000 ft.

*When the SST reaches peak speed performance, it will take about 3½ hr., making possible four flights enroute a day and exposing the skin to certain thermal fatigue stress cycles per day.

*The primary concern on the high end of the SST is an airframe operating life of 10,000 to 90,000 hr. over a 15-year period and no fatigue.

Test Progress

To provide for such a life span, 30,000-hr. tests should be started as soon as possible on certain alloys to determine what loads they can bear for that length of time and what strength they have afterwards.

"Unfortunately, with the alloys under consideration, we cannot with any reasonable degree of assurance predict life or retained strength after 30,000 hr. from short time tests," Deonish said. "This means it will take on 30,000 hr., or a little over three years of continuous testing, to gather this data. If the pro-

cess, stainless steel and super alloys, is used,

Comparing these metals, Deonish said aluminum alloys do not retain their strength above 150°F and can be anticipated to fail only on impact at the Mach 2.5 range, in which case, Deonish said, knowledge of the behavior of aluminum at the time of failure, formability and low cost make it an attractive material, however, and has reduced some thinking about the use of an exotic, expensive bonding process to gain it strength qualities close in speed.

Deonish said that even though the SST probably will operate first in the Mach 2.5-3 range and requires capable of probing it to Mach 3.5 becomes available, the more basic aircraft structures will be used in all phases of the development.

*For this reason, the emphasis intended for the initial design seems most capable of withstanding the heat and stress expected in the Mach 3.5 range," he said.

67 Alloys

In the three remaining metal classes, Deonish said, 67 alloys show promise but since the SST program to date is concerned primarily with proving the feasibility of constructing the airplane, no attempt has been made to single out specific alloys as being most suitable. The alloys will have classified in general groupings, such as a strength-to-weight ratio basis.

The stronger alloy in the basic is 67 Ti-15 precipitate hardened intermetallics in the XH11 condition, Deonish said. "But all 67 alloys have strengths which make them attractive."

Deonish said "TV 36 reflects how signif-

SHEET MATERIALS CONSIDERED IN THE SST SCREENING PROGRAM

STRENGTH	STEEL ALLOYS	SUPER ALLOYS
AM350 CR	41 ALLOYS	NICOB, BASE
AM350 QT	T1&M1 MOIV	RIINI 41
AM350 QT	T1&M2 2.5M	INCONEL 718
AM350		E 270
PH 13-7 RH 1050	H&E ALLOYS	
PH 13-7CH 100	T1 461 MV	INCONEL W
PH14-AMG 18B 950	T1 461 3MD IV	INCONEL X
AM 36L CR34-37 M75	T1 461 2.5CH 125D	D 319
	T1 811 10V	WASPALLOY
		INCO 701
	B ALLOYS	CORAL BASE
	T1 114 TCR 3A1	L 605
		V 26
		M2N BASE
		A 286
		N 55

Titanium vessels of unlimited size for liquid hydrogen

TMCA's cryogenic grades...and

Beech's experience with
7,000 gallon tank open way to

Titanium can hold more liquid hydrogen at less tank weight than any other metal, and will give you insensitivity to hydrogen, generous elongation and notch toughness down to minus 423°F.

In brief, titanium that becomes the easiest way ever devised to buy more payload. And titanium can be used to produce tankage of unlimited size. Here's proof:

- 1 Beech Aircraft has successfully hydrotested a 7,000 gallon welded titanium tank, produced under an Edwards AFM contract.
- 2 Timet Metals Corporation of America has introduced titanium alloy compositions modified especially for liquid hydrogen service. You'll have to know as much as possible about them — it's fast in progress — to keep ahead of the LH₂ field. TMCA can help you here.

One-third lighter than stainless. The Beech titanium test vessel measures eight feet in diameter by 24 feet in length. Although its weight is diminished, it weighs almost one third less than a theoretical optimum stainless steel alternative.

The success of the titanium test tank — the largest assembly of its type yet built — makes even larger vessels practical. It was fabricated from sheet supplied by TMCA to less than AISI tolerances, in thicknesses ranging from 0.016 to 0.025 inches. Beech reports that the weight of their titanium test vessel could be reduced by 50%, by using even lighter-gauge sheet and designing with titanium's high strength and ductility at liquid hydrogen temperatures.

Titanium grades for liquid hydrogen. Timet Metals Corporation of America has introduced two grades of titanium modified specifically for service at liquid hydrogen temperatures. They are the "ELI" (Extra-Low Intensified) grades, Ti-6Al-4V and Ti-5Al-2.5Mo. The Beech tank was produced of Ti-6Al-4V ELI. Both alloys have strength-to-weight

Table I — Typical Tensile Properties of Ti-6Al-2.5Mo ELI

	Test Temperature	
Yield Strength, psi	187,000	340,000
Tensile Strength, psi	172,000	381,000
Elongation, %	18.5	19.0
Reduced Tensile Strength, psi	180,000	374,000
Reduced Elongation, %	1.38	1.16
Reduced Unnotched Ratio		1.83
$\delta_c = 0.3$		

Table II — Typical Tensile Properties of Ti-6Al-4V ELI

	Test Temperature	
Yield Strength, psi	187,000	220,000
Tensile Strength, psi	190,000	380,000
Elongation, %	14.1	12.9
Reduced Tensile Strength, psi	180,000	358,000
Reduced Elongation, %	1.81	0.14
$\delta_c = 0.3$		

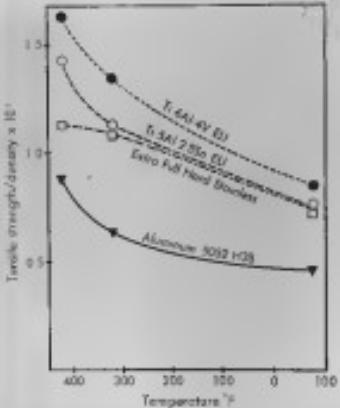
ratios at cryogenic temperatures that are superior to stainless steel and aluminum. (See Figure 1). At the same time they retain toughness — a fact that few materials can approach. Control of intensities also enhances the rolling characteristics of the grades in production of wide, thin sheets needed for LH₂ programs. For example, material is now available in such representative sizes as 0.016 x 36 in. x 240 rad. 0 (0.05 x 40 x 120 in).

TMCA your best bet in titanium. The best bet today for cryogenic tanks in high-energy vehicles is titanium. Its successful fabrication in large tankage, such as the Beech unit, underscores the fact that fine-grade titanium sheet is here. And if your best bet is titanium, then TMCA is your best bet in titanium. TMCA is the nation's only company devoted exclusively to titanium and is the only organization with the experience provided by an extensive history of full-time technical assistance.



Note for complete
data on the "ELI"
grades request.

TITANIUM METALS
CORPORATION OF AMERICA
909 Broadway, New York, N.Y.
Phone: BREWster 5-6100



Comparison of strength-to-weight ratios of aluminum, stainless steel and titanium

Figure 1. Curves show superiority of new ELI grades of titanium to stainless steel and aluminum, on a strength-to-weight basis. Called Ti-6Al-2.5Mo ELI and Ti-6Al-4V ELI (for extra low intensities) the new cryogenic titanium grades also retain toughness at low temperatures and impermeability to hydrogen.

Largest titanium assembly ever made, the 3,000 gallon test vessel designed and produced by Beech Aircraft, measures 8 feet in diameter by 24 feet in length.



"INFRA EYE"

*Honeywell Photoconductive
Infrared Detector*

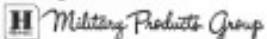


New capabilities in pin-point photo-reconnaissance are now made possible by Honeywell's Photoconductive IR Detector. Systems utilizing the high responsiveness and detectivities of this unique indium antimonide detector produce highest resolution infrared maps.

Available now in production quantities, this new IR Detector offers performance characteristics and design flexibility previously unavailable to photo-reconnaissance systems designers. Special

integrally cooled Dewar designs are also available. For details, contact your nearest Honeywell representative, or write: Minneapolis-Honeywell, 1400 Soldiers Field Road, Boston 35, Mass. Dept. AW 15.

Honeywell



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allowable cold reduced to 40% for example, margins to work with the system components.

NASA has had a program underway for about 11 years to complete data on most of the above under consideration. Dutchy [Dutch] outlined some of the basic findings for each of the three categories:

- **Steel-Precipitation hardened stainless** that can be produced with tensile strengths as high as 300,000 psi in the cold-worked condition. These are rated at top temperatures of 900°, but fail to be heated by their creep strength. Stainless steel AISI 304 is one of the more promising because of the very high stress obtained when it is cold-worked to about 60%

- **Monocrystalline silicon** allows greater all-around in heat resistance, too, up to about 1000°, and allows safety margin for use in portions of the SST. Typical alloys in the right alpha-beta and delta beta eutectics are included with the high-strength alpha alloys showing some superplasticity.

- **Semiconductors**. These weld, weld and now have alloys that do not appear suitable because they are expensive and difficult to have persistence in the cold-cooled condition in which the heat generation often occurs. They are also selected for use in high temperatures, however, and therefore will have applications in the hot exhaust areas. Their stability, electrical methods also make them attractive for use in the 900 to 1000° range as well.

Ideally we would like to let the aerospace engineers compare them with the mechanical properties of such alloys and make a selection on that basis," Dutchy said. "Unfortunately, no bulk mechanical property data can yet be had for these materials especially for the high strain and temperature range.

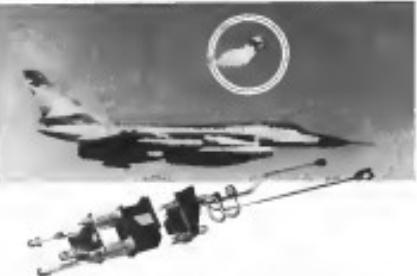
To complete some of this data, NASA has been conducting a screening program to weed out the less promising alloys. Toughness was evaluated by using the standard ASTM edge-weld-toughness test; stability in vacuum properties were studied by measuring tensile strength after 1000° for tensile load at 600° and resonance susceptibility was evaluated by salt water tests.

Complete data on these NASA tests should be available by the first of the year.

In addition to this, the NASA materials group has drawn up a new formula for calculating the alloy's ability to pass the resonance tests. Detailed characteristics on which the alloy rating is based are listed on a chart in the references.

The last category is called the "gray metal" category and in it alloys are used on basis mainly that they can be cold-rolled and formed and how they react oxidation. If

Stepping into Space



... at supersonic speeds



Reentry System



Post Separation



Pulse



Post Burner



Cassette Burner



Primer Jettison



Other

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MS-7000 is used to "analyze" samples such as this. The instrument can analyze up to 28 elements simultaneously. It can also analyze samples containing up to 100 different elements.

Good trip up
Now analyzing 28 elements
Complete right away.
Transmitted.
GC*



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Beckman RS-70 chromatograph—
a precision analyzer in a new, demod-
ernized design for NASA-JPL.
In conjunction with Project Surveyor.

Designed to travel on the initial moonshot, a Beckman gas chromatograph will go to work, analyzing 28 constituents of clouds of lunar dust scooped up and fed to the RS-70.

In 1961, when NASA JPL asked Beckman to take on the job, it was creating pressure equipment that could resist the pull of 300 g, undergo the deep freeze of lunar night, and make analysis on solids rather than gases.

Beckman joined its own engineers and scientists, and gas chromatograph designers, to design a gas chromatograph that could withstand the extremes of atmospheric exposure, fire gas chromatograph in heat, RS-70 unstacked for repositioning, surviving the design, environmental stability.

The gas chromatograph gives the first indication of the spacious gas chromatograph's potential. Tomorrow, the RS-70 support system for manned flight will demand even more on the precision performance of Beckman's chromatographs. For complete information on space gas chromatographs, write to Manager, Commercial Sales.

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Beckman

INSTRUMENTS, INC.
Fullerton, California

an alter, runs poorly on any of the three approaches, it is eliminated. Those which pass the requirement are then checked on the second stage, and other characteristics strength, brittleness, welds, stiffness, fatigue, conductance, welded strength, thermal stress and cost.

Number values of 1 through 5 are used to designate both the importance of each characteristic and to indicate the extent to which the alloy meets such characteristics. By combining the results, an overall index number is obtained for each alloy.

Final Selection

Demands and the basis for the final selection process will be the intent to prioritize and deleted data available at the time. The end additional information is deleted or lower score areas:

- Low static yield stress—Materials selection thus far has been made with the most assumption that no creep will take place. Under extended exposure to the fluctuating temperatures that will be found on the SST, however, creep may become a factor and it should be further investigated.

• Toughness—A metal should be made from static strength testing to a measure based on fracture mechanics. Of equal importance is the duration of testing to determine damage on the basis of true load, which may be used at low-temperature to detect fracture below the 32° m, on which next testing has to be done.

• Corrosion—This question requires much more investigation than we've pursued first to provide protective coatings to resist the heat environment, and second, to evaluate after stress on mean characteristics under cyclic simulated operating conditions.

• Fatigue—Data in fatigue characteristics and the surface topography are particularly similar. First specimen, minimum life data is of greatest utility if it is obtained by using loading spectra and temperature cycles that simulate actual usage.

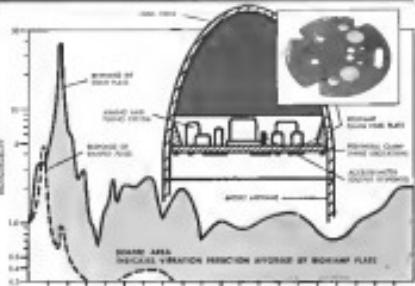
RS-70 Program

Demands and information of a general nature will be derived from Agilent's response: RS-70 program, but the operating parameters and life expectation of the two models are so different they cannot be readily compared.

Basis data on the fabrication of raw silicon wafers, the construction of long-term crack panels and the development of suitable coatings for bonding materials must be gathered and final data analysis in which the SST will benefit from the RS-70.

Studies of noise and traffic control problems with the RS-70 also will prove valuable in developing SST design and operating requirements.

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Adding stiffness (and that usually means mass) is seldom a satisfactory answer to the problem of structural response to shock and vibration. Adding damping is a much more promising solution.

New Barry Controls offers two types of damping...the original RIGIDDAMP® technique, and a new pressure-sensitive additive damping.

RIGIDDAMP structures, with built-in damping, have proven time and again that 200 cps have high-strength structures and maximized damping response.

• Fatigue—Data in fatigue characteristics and the surface topography are particularly similar. First specimen, minimum life data is of greatest utility if it is obtained by using loading spectra and temperature cycles that simulate actual usage.

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If you're concerned with the behavior of complex or complex structures in dynamic environments...if structural fatigue, noise transmission, high acceleration levels, or improved reliability are problems to you...ask for more information about Barry damping techniques. Data Sheet AI 1300, "Selective damping for existing structures"; Bulletin 60-35, "RIGIDDAMP technique for bulletin damping"; Just write Barry Controls, 700 Pleasant Street, Watertown, Mass., or 1490 Flower Street, Glendale, California.



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Flights and radio operators move in this RCAF/McDonnell CF-101B Voodoo jet interceptor during a posture check assembly for Norad exercise

RCAF Squadrons Flying CF-101B Interceptors



Personnel perform checks on CF-101Bs at Ontario station just before start of a mission, above. Turn-around armament demonstration, below, shows rapid loading of Hughes Falcon air-to-air missiles on the aircraft



It is fast RCAF supersonic jet aircraft

In Norad Support

Five Royal Canadian Air Force squadrons are now flying the McDonnell CF-101B Voodoo supersonic jet interceptors as part of RCAF's North American Air Defense Command (Norad) operations. Squadrons are located at CFBs Moose Jaw, Saskatchewan; Quebec City, Quebec; Gagetown, New Brunswick; The Pas, Manitoba; and another interceptor base, regular airbase Aéroport CF-101s in RCAF (AFW) Mirabel, Quebec. CF-101B is powered by two Pratt & Whitney JT3D turbofan engines producing more than 30,000 lb total thrust with afterburner. Maximum speed is more than 1,200 mph, and peak operational altitude is above 50,000 ft.

Ground personnel stand away from CF-101B, above, as safety procedure during liquid oxygen loading. Drag chute landing is shown below.





RAAF Gets First Bell HU-1B Rescue Helicopter

First of eight Bell HU-1B helicopters, painted olive with Diego light vertical markings was delivered recently to Royal Australian Air Force. Remaining seven will be standard olive drab. Helicopters will be used by search & rescue squadrons & their value at contract was about \$4 million. Pilot and ground crews received training at Fort Rucker, Ala. and at Bell's Fort Worth Tex., factory. Contrary view of interior cockpit shows difference between right-hand cockpit (left) from the former between this aircraft and those ordered by U.S. Army is electronically operated hatch, helmet sight and electronic equipment. Hatch has 600 lb load limit and explosive-activated cutting device for dropping load in an emergency. Access installation is now as shown below left.



minus one for paper

	S	P	R
S	0	-1	-1
P	-4	0	-1
R	1	-4	0

The payoffs are known. The Scissors-Paper-Rock game instinct⁺ provides a mathematical abstraction of the conflict situation. Now a Game Theory analysis can be performed. Its objective is to answer the question of how best to play the game. The strategy options in military conflicts are exceedingly more complex. To select the optimal course of action is the major move in our global game. To this end our engineers design command and control systems today for tomorrow's offensive and defensive moves. If you seek to develop your scientific skills to determining long range strategies and their associated tactical systems, you will find us generally receptive to your original thinking. Engineers, mathematicians, and scientists are cordially invited to apply. A good first move would be to send your resume to Mr. Harry A. Larr at 6700 El Camino Conejo Park, California. He will counter with an immediate response. Our Litton Systems, Inc. is an equal opportunity employer.

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Its low density is high density — 8.98 Dens. in. With depleted uranium, you can fit the heaviest possible weight into the smallest possible space.

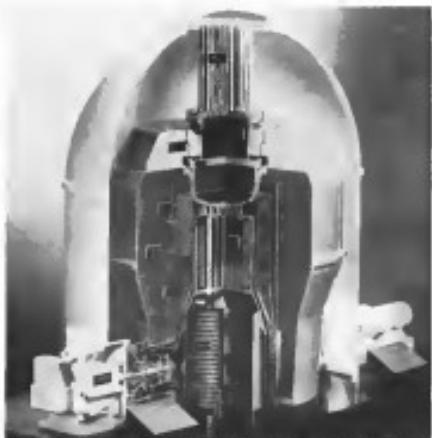
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MODEL OF NUCLEAR Using gaseous heat in Cf for the motive we then nuclear heat at above the boiler. Air is heated to 1,200° in the nuclear and circulated through the boiler passing over. System is rated at 10,000 bhp.

Testing Set for Engine Developed From Nuclear Aircraft Program

New York-New Jersey nuclear powerplants developed by General Electric Co. have experimental nuclear engines, originally designed for the now defunct Aircraft Nuclear Propulsion (ANP) program, which failed to begin full-scale development.

Testing of the nuclear steam generator developed at ANP will be done at Atom Energy Commission's National Reactor Testing Station in Idaho. The reactor, 34 ft. high and 18 ft. dia., weighs 340 tons and will develop 50,000 bhp, according to Bob Blehberg, manager of the ANP development program.

Part now with the ANP funded engine will be used, as planned, to prove the safety of the engine design, according to Blehberg. Power output will be low.

Blehberg said the new engine is based primarily on G.E.'s Heat Transfer Reactor Powerplants (HTRP-1) engine built in 1958, although it draws on much recent advances, with 12 major changes made during the ANP program between 1958 and 1968.

It is a closed cycle unit consisting of a water-cooled reactor set above a steam boiler. The reactor, built with 67% enriched U-235, replaces the boron in a conventional oil-fired boiler. The two heat exchangers are designed for a 1,700° bhp at 4,000 rpm.

Air is heated to 1,200° in the nuclear and circulated down through a hot-air screwdriver, which produces 912°F air at 500 psig. After the air has passed through the boiler cycle, it is circulated through the reactor by a blower.

"Using air as the working fluid has made possible improved performance over the high-pressure water systems used in older nuclear engines," Blehberg said. "We can heat the air to 1,200° as opposed to 700° which is the maximum temperature that can be attained with a pressurized water reactor."

Blehberg said the air system had two other advantages—simplified safety and a greatly reduced factor.

The circulating air, in addition to

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INITIAL GUIDANCE SYSTEM

Left: An armillary sphere on the second anniversary of the Moon landing, and armillaries donated for a bit — as evidenced by this early Transonic armillary.

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Transonic places its emphasis and understanding of systems for the measurement of level, temperature, pressure, and flow — a function of measure and relating to it. Never one to be complacent — a pride in solving the tough ones.

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AT RADIATION, IDEAS BECOME REALITY

Example: Telstar's 8 lb./112 channel PCM telemetry system

Bell System's Telstar 1 communications satellite in orbit transmits via the West Atlan-Sub-sea cable to prove the feasibility of under-sea communications, but also the reliability of a new transmission technique. PCM telemetry has now won its place as the most advanced method of checking satellite performance.

Telstar's PCM system, built by Radiation-Melbourne for Bell Telephone Laboratories, weighs only 8 pounds, requires less than 450 milliwatts of power... yet provides 112 information channels at 8.4 megacycle invisible today. Channel elements: 16 voltage, 40 temperature, 9 current, 37 nonresonant elements; 3 pressure, 10 solar energy and 8 relay links.

But analysis of Telstar's telemetry data - reviewed by the Radiation designed and built commercial tracking instruments - indicates the satellite pressure is still about 5.5 lbs./sq. in., showing that the container has not been punctured. Average nonresonant mode of 25°F, average sun temperature of 20°F, solar cells delivering 0.5 amp at 13.5 W and a radiation-

induced decrease in current output of 10% (at 20 miliamp) is shielded semiconductors and 25% (at 20 with 25 or 30 mils passive shielding).

The innovative new telemetry technique is only one of many advanced projects on which Radiation scientists are now working. They like to explore uncharted concerns you'll find in stimulating and challenging environment at Radiation - where ideas become reality. Send your resume or write for more information. Personnel Director, Dept. AW 111, Radiation-Melbourne, Melbourne, Florida.

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Dynamicalistics systems - Data acquisition and processing - Automatic control - 2D systems - Manufacturing

setting as the working fluid) also has an external shielding site. If a fluid circuit should spring a leak, an auxiliary blower can be used to isolate the volume of air circulating and prevent overheating for a longer time than the circulating water system.

Gas Turbine Versions

The 613A, although designed to fit parent machine, also fits with fairly small housing, thus easily adapted to a gas turbine version in the future. The hot air flowing from the reactor will be used to directly power a turbine instead of producing steam.

"In the version, the powerplant can be made small enough for use in high speed industrial boats and in ground effects machines."

Cost of the 613A is lower than current pressurized water reactors, according to the 6000-cwt cost of \$1 million to compare with \$1.5 million for a reactor powering the N.S. Savannah, now's first nuclear-powered merchant ship.

The Savannah's engine weighs 2,412 tons and develops 27,000 shp.

ANF Termination

Hamburg and Ghent decided to develop a monolithic engine incorporating the best parts of its aircraft engine design. Soon after the ANF program was terminated in April, 1961. After the Maritime Administration expressed interest in the first proposals in June, 1961, GM indicated that the ANF program would be concluded in October, 1962. Development of basic components was carried on through the summer with final assembly being accomplished at ATC's little test station.

Hamburg and the Maritime Affairs Institute is now reaching with discussions to discuss a similar conversion program which will save costs of the Johnson traffic and control problems which have plagued the N.S. Savannah program.

AFOSR Grants

An L-101 Office, at Scientific Research has awards secured 37 grants and contracts to colleges, universities, nonprofit research foundations and individual laboratories in their studies and research.

RESEARCH

Laboratory of Weapons Materials, University of Michigan, Ann Arbor, Mich., for development of materials with enhanced self-healing properties.

New York University, Washington Square, New York City, \$44,000 for study of forces in hydrogen bonding and the conversion of cellulose and cellulose acetate.

National Bureau of Standards, Washington, D.C., \$10,000 for methods to locate and identify

the Lycoming T53 small gas turbine engine is currently in use on helicopters, observation aircraft and in Marine and industrial applications. This is the first injection engine successfully developed by Delavan for the T53.

If ever word were chosen to sum up the reason for Delavan's success on the fuel nozzle program, that word would have to be experience. Experience in designing highly functional, reliable fuel delivery and metering devices is

experience in large scale manufacturing of the intricate and precise parts that make up a fuel nozzle, and experience in maintaining the quality and performance of these devices on a mass scale.

Add this experience to Delavan's willingness to react quickly to the urgent needs of a dynamic industry and the results are always the same - excellent quality, a good delivery record, and reasonable prices. Be sure Delavan is a part of your engine program.



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LYCOMING T53 FUEL NOZZLE

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TELEVISION

MMRBM Guidance Techniques Described

By Philip J. Khan

Techniques which may be used for mobile medium-range ballistic missile (MMRBM) guidance and to determine the position of an transportable-vehicle at launch were described recently in a document from General Precision's Aerospace Group, which holds the contract for program definition planning by the Ford MMRBM.

Choice of technique used to determine the location of launch vehicle defines the requirements for the missile's guidance system and vice versa.

Deformation of the position of a mobile missile launcher of the MMRBM type using a combination of inertial reference systems was described in a report by Robert G. Cole and J. P. Snyder of General Precision at the recent Northeast Research and Planning Meeting (Nerem) in Boston.

Transportable vehicle would be equipped with a gyro-stabilized platform which is slaved to the local gravity vector and provides position information by means of accelerometers. Starting from a known reference location whose position was precisely known, the vehicle's navigation system would use dead reckoning to provide the launch crew with a continuous updating of its position.

Fifth wheel type odometer would measure the vehicle's movement. At lower low level speeds would introduce a spurious indication of distance covered relative to a spherical earth, it is necessary to use a spherical platform to cover the vehicle's tilt angle and to modify the odometer measured distance by the cosine of the tilt angle to obtain the actual distance travelled over a spherical earth.

The horizontal distance must then be resolved into east-west and north-south components. The General Precision analysis suggest that this can be accomplished using a north-seeking gyro mounted on the stabilized platform. Such a gyro determines the direction of true north by solving earth rotation and aligning its axis parallel to the earth's axis. It is a technique that has long been used in shipboard gyrocompasses and wave sensors in shipboard inertial navigation systems.

However, when a north-seeking gyro of large size is mounted on a moving vehicle, as would be required for the MMRBM, it can not distinguish between vehicle motion and those due to the earth's rotation. This requires the use of a compensating signal proper-

accurately tests gyros in .00017 hr. drift rate class

The Model 252 Test Table is a highly reliable instrument. It provides extreme accuracy and repeatability for the test of gyros, accelerometers and guidance platforms. A major reason why its design eliminates section producing elements. Instead of a mechanical or liquid film bearing, the table "floats" on air. The 252's direct drive AD torque motor eliminates the problems of hysteresis effects of DC torque motors and of parasitic errors and friction inherent in gear drives. Servo-drives slip rings further reduce action in the table system. Directly coupled electromagnetic transducers take the place of resistive micro switches. A precision instrument-and-use whose modular design allows you the luxury of choosing features compatible with your test requirements. For example

TABLE 252 READOUT can be digital or analog as well as visual with an accuracy of ± 1 arc second and a resolution of 0.5 arc seconds. (Visual readout by fixed-position eyepiece.)

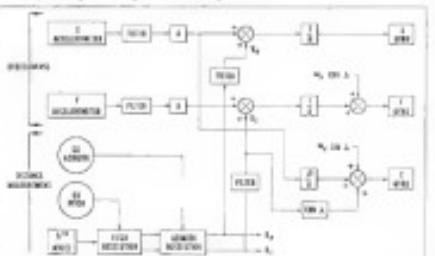
For more information on the Model 252 Test Table or for assistance with your guidance systems test requirements, write to the J. W. Fecker Division, American Optical Company, 4709 Baum Boulevard, Pittsburgh, Pennsylvania.

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NAVIGATION SYSTEM for an MMRBM mobile transportable-vehicle using a fifth wheel type odometer in conjunction with a gyro-stabilized platform to measure vehicle tilt angle, reported by General Precision engineers. In view on center table constructed by company client Chrysler Corporation engineers, shown in photo above.



BLOCK DIAGRAM of a land vehicle navigation system using absolute sensor in conjunction with gyro-stabilized platform which measures vehicle tilt angle and provides directional reference for resolving distance travelled into east-west and north-south components.

tural to velocity ratios, as well as the rate of change of distance traveled, Gide said.

An alternative design approach is to use a Schlieren-based inertial navigation system for the homopilot scheme, since no one said far enough and sufficiently, which automatically stabilizes vehicle position. However, in this case, the stabilized platform oscillator about the inertial system with an 84-mm period is said to be precisely synchronized even after 42 min.

System Errors

With a wheel odometer initial plan error errors errors accumulate only as a function of distance traveled and not as a function of time, as with a Schlieren based system.

Then, when the vehicle is stopped, the error buildup also stops.

Presently, the NVRIM team's motto is expected to take it past one of most persistent challenges, at which time accumulated errors can be cleared.

Combining of stellar and inertial techniques in a single guidance system promises to provide "significant improvements in accuracy, versatility and response time," Bernard Lachapelle of CPI's Acropac Group said at the recent Joint Guidance Test Session.

That was held at Holloman AFB. However, these potential advantages introduce problems not encountered with all-sensor systems. Lachapelle reported. For example, a stellar inertial system must be provided with gyro sensors during the burn phase of a ballistic trajectory, because it cannot be effectively evaluated by rocket sled tests, a common method long used to test inertial systems.

For an MIRIM application, stellar cameras in the inertial sensor would begin a sequence of short 30-sec. intervals and continue until beyond a height ranging up to 500,000 ft, in increments that can not be simulated effectively in a terrestrial sled.

Flight Testing

At these higher altitudes, atmospheric density reduction, absorption of ultraviolet and the intensity of background illumination are markedly different from those at or near sea level. Also, vehicle velocities at these high altitudes are also very broad. Levels which can be obtained with existing test vehicles, Lachapelle said.

The reason that flight testing must be conducted much earlier than an evaluation program flow is evidence with conventional inertial systems," he said.

Lachapelle said that the Godd-

stone Evaluation Module which will be developed under USAF Missile Development Center sponsorship, appears to be ideally suited for the evaluation of inertial systems.

Star-inertial systems require that the star tracker be able to view the required star through a window in the module which is strong enough to withstand high temperature, shock and vibration but which still offers extremely low distortion of the field-of-view. Errors introduced by the window must be limited to a few seconds of arc, Lachapelle said.

Single Window

This suggests the use of a single large window or one consisting of several flat surfaces to form a curved surface.

The latter allows the star tracker to view a larger volume of the celestial sphere, but with occasional blind spots due to structure.

There are two basically different techniques for combining ultraviolet and infrared techniques for a guidance system, Lachapelle pointed out. In one, the ultraviolet sensor is used to make an accurate "second-order" and smooth reference for making measurements of star altitude and azimuth as a coarse scale to the traditional optical navigation technique, except that measure-

SCIENTISTS AND ENGINEERS: As Materials today, formidable new problems are calling for innovative and highly original solutions... the kind of creative manpower that has been successfully applied to the design and development of electronic systems such as the NASA-Goddard High-Rate Data Satellite Tracking System...the Air Force data acquisition and relay system at the Edwards AFM high speed flight corridor...and the EADAS audience access, discrete address system.

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MHD Generator Produces 1,350-kw. Power

Magnetohydrodynamic (MHD) generators which has produced 1,350 kw of power, the highest yet reported and more than 100 times the power developed by earlier models, has been operated for more than 100 hr by Avco Everett Research Laboratory. Before closure of water cooled to withstand 4,000°F temperature of conducting gases produced by ionization powerplant fuel used with potassium to make it an electrical conductor. Area is building 20,000-kw, off-center MHD generator under Defense Dept. contract.





Hughes makes news in armament!

Major breakthrough or major need?—Today's air-to-surface tactical missions require new flexibility in armament. There are a greater variety of small, hard-to-see targets which must be attacked at short range from aircraft flying at low altitudes. Total time to fire is shorter.

The optimum weapon in this difficult environment is the high-rate-of-fire gun. It is extremely accurate. It reacts instantly. It has high lethality against a wide range of targets. Other advantages are low cost, logistic savings, over-all simplicity and reduced pilot exposure.

Gun Ordnance has been a major activity of the Hughes Tool Company—Aircraft Division for more than twenty years. That continuing gun development and production capability has culminated in advanced weapons—ideally suited for today's requirements.

Hughes gun ordnance capability includes the complete system—the gun, its installation, controls, gun sight and specialized ammunition. These systems are tailored to the individual missions of fixed wing aircraft, helicopters and ground vehicles.



Hughes HIPIEG—Brimmed with... Up to the field of operational armament stores, HIPIEG is a complete, high performance gun system. Its Mk. 11 gun fires 100 rounds per minute at a height from 10,000 ft. per revolution of 20,000 gms. It comes up to rate instantly and fires the most powerful three-round volley available. The HIPIEG system combines the gun and 150 rounds of armor-piercing ammunition in a super-sealed enclosure. Developed for the U. S. Navy, it is now available for application on a wide range of fighter and attack aircraft as well as helicopters. Advantages of Hughes HIPIEG: It can be removed for servicing and replaced by landed pods far quicker than ever before. Alternatively, the pods can be left off to allow the aircraft more versatility in non-gun missions. HIPIEG provides three missions per aircraft—greater aircraft utilization. As required, Hughes HIPIEG pods can be installed in multiples to provide greater firepower density or longer duration.



Hughes gunammunition developments include 20mm armor-piercing rounds specially designed for use against ground targets as delivered from fixed-wing aircraft, helicopters and ground vehicles. Also in development, a new 20mm servo round for the MK. 11 gun against sea targets.

* Hughes HIPIEG 20mm Pod with MK. 11 Gun (4000 rounds-per-minute firepower) gives the Navy's AAD mission effectiveness against small targets such as tanks and other ground vehicles.



Hughes Heligas has 1000 rounds-per-minute firepower at only 30 lbs. weight—SEVEN times more firepower per gun than现有 weapons. Designed specifically for assault where heavier guns are prohibited, Hughes new Heligas utilizes gun-pipe power in its 20mm counter-rotating—the HIPIEG. During the T-62/NATO trials, the Heligas will prove its deadly fire-power from both high and low level aircraft or ground vehicles. Features include: Self power, instantaneous rate, Low frontal area, Positive protection from cockpit, hangar and double fire. Projectile or cartridge choice, low velocity census fire and standard M13 links and only 150 lbs average road.

Helicopter Armament Systems—Hughes gun packages—designed for LOH use—can also be easily adapted for other helicopters. One package has a pair of Mk. 11 20mm guns and offers elevation control, quick installation, low drag, special gun mount and a self-contained power source. This could replace existing guns to offer a four-fold increase in firepower and a five times reduction in drag. A dual wing version would position the Heligas in an external pod. An interchangeable package contains the XM-72 grenade launcher.



Ten years of experience applied to expansion of the ring of the art... complete engineering laboratories, enclosed firing ranges and manufacturing facilities in one compact facility. These are the factors which have made Hughes unique as a producer of advanced armament for free world defense. Individuals with a need-to-know are invited to request further information. Please contact the Vice President-Marketing, HUGHES TOOL COMPANY, Aircraft Division, Culver City, California.



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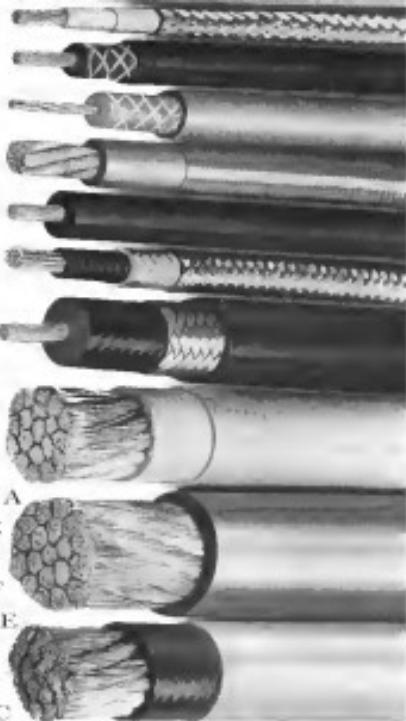
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Lar-Wire Division of General Motors Powers 4500



Laser-Lamp Developed

Laser-lamps, in which laser crystal arrays are enclosed by pumping lasers to provide more efficient coupling, are products of Sem-Electronics, Inc., Louisville, Pa. In operational mode, crystal surfaces are electrically heated to full reliability except at one end where there is a mirror. The output lamp operates below threshold at which laser action occurs, from 100

watts and compensation is performed automatically.

Second approach, which is better suited to believe mobile guidance, uses the star sight to control the initial alignment of the platform gyro as well as the drift that occurs during the boost phase. Sighting on one star provides a means for measuring yaw drift about an axis at right angles to the line of sight.

Using separate sightings on two stars requires an angle approaching 90° to provide sufficient information to align the stable platform precisely about both axes as well as provide a locking reference.

Two separate star trackers can be used to obtain the two star sightings simultaneously. However, a single telescope can be used to sight both stars simultaneously with the guidance computer automatically taking advantage of the different sighting times.

For an application such as the MMRBM, where size and weight are extremely important, the single tracker is preferred.

In conclusion, when the needs have justified a suitable starlite, the computer (IAW Nov. 2, 1961, p. 128) will tell the tracker to find the star should be centered in its field of view if there is an error in the stabilized platform. An deviation between the position predicted by the guidance computer and the actual star position generates a signal which is used to shift gear and platform one coarse alignment.

This means that the celestial star field is the ultimate reference. However, presumably the computer will be designed to go against instrument error rates readings from a star tracker so that the deviations between computed

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(Or: A helping hand for the harassed)

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and extend the position around a 90° angle; counter to which the gyro might have shifted since the last reading, the reading will be ignored.

Solid-State Trackers

Solid-state type star trackers, currently under development, are expected to offer the high response speed of a photoconductive radiation with the sensitivity of the photomultiplier. Photostatic type track in a unit smaller than either, Lichtenstein said. The tracker will use a mosaic of photomultiplier cells, made of silicon such as can be solidified at room temperature, when no electrical power is used. The pattern of pulses obtained during the scan will indicate the position of the star within the field of view.

The tracker itself will be mounted in an integral part of the sensor after each cluster, with two degrees of freedom.

The star tracker technique in combination with inertial guidance yields higher performance tolerances in the radial portion of the system rather than linear, as might at first be assumed, Lichtenstein said. The servo system need to measure radial alignment to the gyro reference must be highly accurate ("less than one arc second") in order that it is an allowable tolerance. To minimize errors due to backlash in the growing drive, drive-gear torque motors are used both to position the inertial platform and the star tracker.

Measurement of platform and star tracker angles must be extremely accurate, which suggests the use of digital tape readouts, particularly since the guidance computer is of a digital design.

The stabilization gyrostabilized outputs are fed flight control hydraulics rather than as part of the inertial compensation.

This cuts the accuracy requirement associated having it dependent only upon the needs of the flight control system.

Error Limits

All of these errors, including those introduced by the viewing window or the mirror mount to be located, to "a few seconds of arc," Lichtenstein said. At the earth's surface, an angle of one second of arc corresponds to 100 ft. A total of 10 sec. of arc accumulated over four full scans could result in a range of 1,000 ft.

The figure of 1,000 ft. is believed to be the CEP (circular error probable) (1 sigma) for the mobile guidance range guidance mode.

Building and testing a stellar inertial version to this degree of accuracy will demand a major upgrading of instrumentation to assure that it meets design objectives, Lichtenstein concluded.



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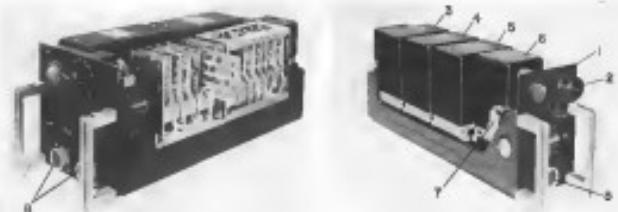
Screening on a cushion of hydrogen gas—instead of bell housing, it out-survives its predecessor—the best until now—is three times over. It takes ferocious G forces without performance loss...shakes off temperature change and magnetic field interference. Its servo loop is twice better than the next best; its random drift is almost non-existent. Its time proven "gyro-suspension" system guarantees reliability. It's

the sum of 40 decades of design excellence. It's efficiently compact—1/7th the volume of the total comparable instrument—and rugged. It has universal use from deep space to deep sea.

It is the Mark I, Mod 3 Gas Spin Gyro produced by Sperry Gyroscope Company for purposes of inertial navigation.

SPERRY

SPERRY GYROSCOPE COMPANY, DIVISION OF SPERRY RAND CORPORATION, GREAT NECK, N.Y.



CONTROL RACKS for pitch (left) and roll (right) channels of SP 50 autopilot, now in production and scheduled for use in at least 125 Boeing 727 short-haul range aircraft, have quadrature and quadrature cell test capability, the indicators and switches for which we show (1 and 2). Other items in view include pitch potentiometer (3), vertical pitch coupler (4), trim coupler (5), pitch servo amplifier (6), rate gyro test decoupler (7) and system test set switch (8).

Sperry 727 Autopilot Stresses Reliability

By Harry Miller

Passenger Auto-Automatic flight control systems designed and being produced here for the Boeing 727 short-haul range jetliner will reflect an unusually heavy emphasis on reliability as an effort to cut maintenance costs, boost pilot confidence and enhance public safety from 727 automation.

Autopilots designed SP 50 and being manufactured by Sperry Phoenix Co., will incorporate a galileo-type error correction to give the avionics an all-weather, low-speed capability aimed at achieving a maximum altitude goal of about 175 ft. This is to serve flight-deck crewmembers, flight engineers and operators of the Douglas DC-8 as an independent approach method for aircraft (AW, Dec. 11, p. 35).

While the SP 50 includes a number of technical advances, the stress is on development efforts to insure its reliability from the component to the equipment level. The desire to emphasize maintainability and minimize downtime also figures prominently in the design philosophy. Thus, the autopilot is packaged in separate units for yaw, pitch, roll and an area circuit equipped with provisions for each unit to generate self-test.

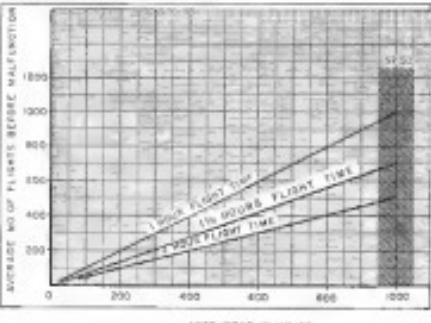
The autopilot contains, weighed with five of the company's SP 10 auto-pilots (AW, Nov. 26, 1966, p. 26), which introduced many innovations to meet rigorous substantiation requirements posed by the emergence of commercial jet transports.

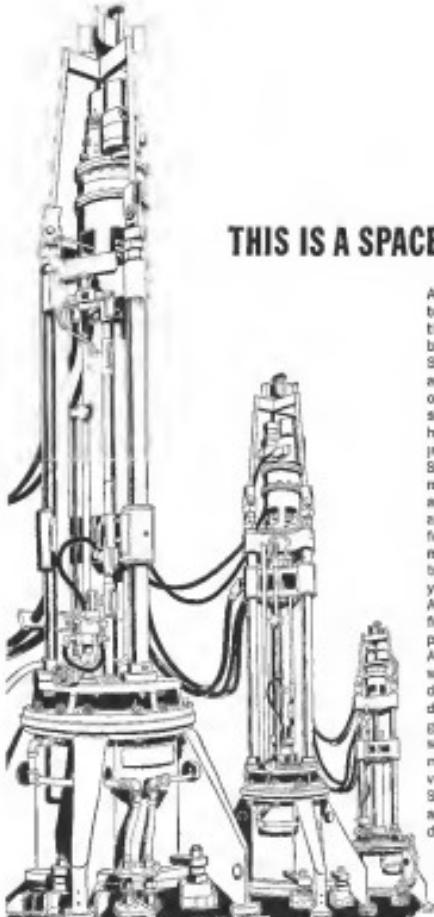
Now that the company has acquired an air transport autopilot experience, the new autopilots do not appear technically startling.

One notable innovation of the SP 50 has been the use of inertial stabilizers, which substitute accelerometers



AUTOPILOT CONTROL PANEL for SP 50, above, has single integrated yaw and pitch track switches designed primarily for ruggedness and reliability. Below, graph shows unusually high average time between failures for the SP 50.





THIS IS A SPACE AGE STEEL MILL

At first glance these units appear to be small missiles, secure on their launching pads, awaiting blast off. But they're furnaces, Space Age steel furnaces located at Latrobe Steel Company. • Out of these furnaces come Vac Arc steels, the special high strength, heat resistant alloys needed for jets, missiles, rockets and other Space Age products. Ingots are remelted...drop by drop...under a high vacuum to remove gases and impurities from the alloys before they are sent on to the rolling mills and forging presses. • Latrobe Steel, currently in its 60th year of business, entered the Space Age in February, 1959, when the first arc was struck in the company's first vacuum furnace. In August, 1961, a second furnace was installed and in 1962, with the demand for the super alloys produced by Latrobe's furnaces so great, both a third and fourth unit were added. • These new furnaces are just one step in the diversification and growth of Latrobe Steel, a company long recognized as the leader in quality tool and die steels.

**LATROBE
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by rate grows and aluminum fooblock at certain points, perhaps.

Approach was first employed in the SP-70 for several reasons. Primary among was the desire for dual sealed packaging, with its simplified interconnection and reduction in weight. The channeled approach lends itself to the use of rate gages which can be satisfied in such channel packages. Accelerometers would have to be mounted outside from the channel walls.

Besides the initial advantage of single channel packaging, each flight set of the complete unit can be engaged and operated independently, thus permitting eight separate, independent control in pitch and maneuvering in yaw.

SP-70 employs dual yaw dampers mounted through separate struts to the aircraft's yaw rudder, thereby giving the aircraft a measure of fail-safe operation. In the event of failure in one, there effectively is a redundant yaw channel. The system has potential for growth as additional dual channels on the other axis, a move toward a flying pilot controller, is going to later versions.

The system can be in operation throughout flight, including takeoff and landing. With the exception of the yaw channel, all axes of motion are reflected at the nadir probe, according to the manager. The pilot will be able to maneuver the aircraft with his radioles control without experiencing an opposing force from the yaw damper.

Other Features

Other technical features of the autopilot include:

- Improved crosswind correction in pitch;
- Aerostatic stabilizer trim monitoring;
- Aerostatic feedback VOR capture points prior to set intercept angle;
- Rate gyros; stability/directional integrated ram and park sensors.

Sperry has made several efforts to improve autopilot reliability. First, electrical components were selected with reliability and robustness as major considerations. Only four types of transistors are used and these are high-quality parts.

In one case a component type evolved from the extensive reliability improvement program for the guidance system of the Minuteman ICBM (AW 20, p. 57).

Whenever possible, solenoid casings, switches, relays, were redesigned for potentially more traditional electromechanical parts.

Relays are designed so they do not exceed 35% of their rated dissipation limit at 75°C. Capacitors are operated at half, or less, of the specified operating voltage rating, gate-to-anode compensation at less than 50% of manufacturer

specifications, total power dissipation for heat sink cooling is 100° C.

Computer analysis, however, indicates the complete autopilot, including dual yaw damper, will have a mean time to repair failure (MTBF) of 1,000 hr., about three times higher than field equipment.

An extensive reliability audit was conducted, under which all parts are evaluated in databases that ability to meet system requirements. Before approval, each part undergoes environmental and life tests conducted by the parts' own suppliers, usually subcontractors. Test data is collected, resulting levels of each part measured with respect to an MTBF and derived, calculated, on the basis of standard reliability data for the parts. This information was audited and incorporated in manufacturing drawings.

Average component repair cost in the system, according to Sperry calculations, has an MTFR greater than the reliability-dependability ratio, of 63,600 hr. Only one out of every three cards will malfunction during the average 10-year operating period of an aircraft, the company says. System reliability is based on summation of component failure rates.

Other factors expected to contribute reliability include a closed-loop validation in the parts count of the system compared with other conventional autopilots, more extensive use of infrared feedback for longitudinal stabilization, reduction in the number of mechanical connections and relays, and more rugged mechanical construction.

Following steps were taken to improve maintenance:



Photometers Detect Nuclear Debris

Optical photometers, developed by Geophysical Corp. of America, detect presence of nuclear debris from high-altitude nuclear explosions by observing scattering of sunlight from debris and identifying spectral lines of toxic elements of debris elements.

• Construction—Racks containing equipment for each channel consist of a number of plug modules, each corresponding to a complete function or several functions. Within the modules, 750 sq. inches circuit boards, on which components are mounted, can be pulled out and replaced while the equipment is in place. This gives aircraft a chance to troubleshoot equipment in an emulated state. Each module has a base potentiometer for controlling the sensor. Another feature is a solid-state isolator, one potential module can be replaced without having to interrupt power supply to the module.

• Self test—On the front of each channel is a logic test connector which permits a technician to make nearly 100 tests with the aid of a portable semi-automatic logic test audience on about 15 min. and with a 95% confidence factor, according to Sperry.

• Safe test—On the front of each channel is a logic test connector which permits a technician to make nearly 100 tests with the aid of a portable semi-automatic logic test audience on about 15 min. and with a 95% confidence factor, according to Sperry.

• Safe test—On the front of each channel is a logic test connector which permits a technician to make nearly 100 tests with the aid of a portable semi-automatic logic test audience on about 15 min. and with a 95% confidence factor, according to Sperry.

The sensor, which obtains attitude information, may be used for monitoring glidepath entries.

Part of at least 128 production SP-70 autopilots has been delivered and is expected to be certified late next year.



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DIVISION

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When you follow these welding instructions— you can perform wonders with UsS "T-1" Steels

USS "T-1" Steel, and "T-1" type A, are two of the most versatile steels ever developed. They combine very high yield strength (100,000 psi minimum), outstanding toughness, and ready weldability. Designers have taken advantage of this remarkable combination of properties to build stronger, lighter structures of many types, and to improve the performance of an impressive array of heavy duty equipment.

Achieving great strength and toughness in a steel is not an earthshaking event. But combining these properties with weldability, as in the case of USS "T-1" and "T-1" type A Steels, it is the weldability that permits the designer to take full advantage of the strength of "T-1" Steels.

Being heat treated constructional alloy steels, USS "T-1" Steels require different welding techniques than other heat treated steels. These are not difficult to learn. Current Steels, relatively new, and developed when the following recommendations were followed. We invite you to read them as a guide to realizing the full benefits of USS "T-1" Steels. They are detailed in a booklet which includes a Welding Heat-Input Calculator, and in our new welder-training film, "How to Weld USS "T-1" Steels" (see opposite).

RULE 1—Use the proper electrodes

When manual arc welding "T-1" Steels, use only electrodes with low-hydrogen coatings. Or, use a wire arc welding machine which is "low hydrogen" such as inert-gas shielded arc or submerged arc welding.

Hydrogen is the number one enemy of sound welds in "T-1" Steels, as in all alloy steels, because it causes intermetallic cracking, resulting in unreliable joints.

To be sure you have selected the correct electrodes, remember that low-hydrogen coatings are designated by the last two numbers of the electrode classification as 15, 16 or 10. Hence, other, for example, E6015, E6016, and E11018 are unsatisfactory for welding USS "T-1" Steels.



When you want to be positive that the finished weld will be as strong as the parent "T-1" Steel, use E11018, -16, or -18 rods.

Never use electrodes or wire flux combinations containing vanadium to weld "T-1" Steels if the weldment is to be stress relieved. Weld metal containing vanadium is likely to be made brittle by stress relief (Goss effect) is only necessary with "T-1" Steels when re-

quired by codes and one or two other special cases.) When welding "T-1" Steels to a lower strength steel, use low-hydrogen rods of the strength level recommended for the base metal.

Proper handling of electrodes is also important. When exposed to air, low-hydrogen coatings will pick up moisture which is a rich source of hydrogen. Keep your electrodes dry. Make it a practice never to open more than 30 minutes' supply of rods at a time. A sure way to keep rods dry is to keep them in a 250-300°F oven. If your rods have absorbed moisture, heat them over fire. In an oven according to the manufacturer's recommendation. One hour at 800°F is average.

To sum up Rule 1, for arc welding use low-hydrogen electrodes and keep them dry. For submerged-arc or inert gas shielding arc welding, use thoroughly dry fluxes and water-free shielding gases.

RULE 2—Use correct welding heat

On most kinds of structural steels, high heat input results in superior welds. With "T-1" Steels, just the opposite is true. The best welds in "T-1" Steels depend on never getting over a certain maximum amount of heat. Low heat is used so the weld will cool quickly which, in "T-1" Steels, results in good, tough welds. Thus, you must closely control the amount of heat put into the weld.

For this reason, never preheat "T-1" Steels except in specific cases. Preheating is sometimes required to get rid of a foreign material or foreign welds that are harmful to welds on "T-1" Steels. The times in which preheating is necessary are those in which the steel must be heated to get rid of excessive moisture (hydrogen source), where the place is so restrained it doesn't have room to shrink when welding, or when thick pieces over 1" are being welded. Much of the time, however, preheating isn't necessary, and never prevent "T-1" Steels from being welded.

The heat you put into a weld depends principally on amperage and the speed at which the arc travels along the joint. The higher the amperage, the more heat input. Thus, the higher the amp, the higher the heat input. Controlling heat input requires keeping amperage low, certain settings and keeping the speed of travel above certain speeds.

There are two other important means to keep track of steel thickness and temperature. Thicker sections can safely soak up more heat than thinner ones, so you can use more amps and slower speed. As for temperature, the section may have been heated up by pre-heating or by previous passes of the electrode. So if the section is already hot, you must cut down on amps or increase speed to avoid excessive heat input.

Heat Input Calculator

There's an easy way to determine the safe heat input for USS "T-1" Steels—the circular Heat Input Calculator which is provided with the book offered in the opening. With it you can quickly find out what amount of heat will result from any given setup, and determine how much more you can safely put in. It is a



circular "slide rule" which tells, on the front side, how much heat will be put into the joint if you know the amperage, voltage, and arc speed. On the back side of the calculator are tables showing the safe heat inputs for "T-1" Steels in several different thicknesses at different temperatures. This handy device is designed to help you get good welds every time. Heat inputs may also be calculated from this formula:

Heat Input per Inch =

Amperes x Arc Voltage x 60	Weld Seconds (Inches)
Speed, inches per min.	Per Inch of weld

RULE 3—Use recommended welding procedure

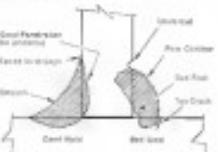
The straightforward straight-bead method is preferred for welding "T-1" Steels. Do not use the "V-joint" method. Beavering heats the metal more because the arc travel speed is slower and may cause excessive heat input. The proper method is to fill the groove with a succession of stopgap beads.

Before a bead can be laid out an earlier bead, the flux, oxide, or oxidation must be removed.

Back gouging. This preferred method is arc gouging followed by clean-up grinding. Do not use an oxyacetylene torch. There is danger of overheating which may cause an intermetallic joint.

Spool. Whether you control speed by machine or hand, control it closely. The Heat Input Calculator described above is your guide to the proper speed to avoid excessive heat input.

Fillet welding. Good fillet welding technique is more important with "T-1" Steels because the joints are usually required to withstand greater forces. Fillet welds in "T-1" Steels should be smooth, correctly contoured and well fused to the legs of the piece to be joined. The laps of each weld should be made so that there is root-to-root penetration but no undercutting. The weld shown on the left is ideal, the one on the right is to be avoided.



When thick pieces are joined, and when the weldment is to be stress relieved, fillet welds can be troublesome because of ice cracking. There are several

ways to eliminate ice cracking near fillet welds on "T-1" Steels. In the case of T-ee or GT joints where lower strength welds are often the rule, use low-hydrogen rods of the E90, E80, and E70 classes. Being lower in strength and more ductile, they are less likely to fail if cracked at the toe of the weld.

An alternative procedure for the weld can also be very helpful in preventing cracks, especially if the weld is to be stress relieved. Joints made even with the higher strength rods (E100, E130 and E90) should be free from toe cracks if peened. Sometimes it is necessary to peen each pass, at other times, peening only the last passes will prevent cracking. After peening, the fillets should be smoothly ground to take the Mett into the legs of the joint.

Other methods that can prevent cracking include use of a soft wire pedestal, machine grooving the base of the upright pieces, and laying down "bullets" with the toe area. The first two methods allow the upright leg to "sink in" while the "bullet" weld strengthens the joint. Seats in the end pieces can also crack when started. It is good to prefer to avoid fillet welds and must be located so that the toe portions of the fillet will be laid right over the strengthened zones.

Free Welding Help. The above information is copied out in greater detail in our free book "How to Weld USS "T-1" and "T-1" type A Steels." Included in the book is a Heat Input Calculator that helps the welder choose the proper welding speed and amperage for each job. You'll also find other information, tables, color coded melting patterns of the same series, a big help in understanding for your welders the proper techniques for welding USS "T-1" Steels and the equally "T-1" and "T-1" are registered trademarks.

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This issue is really a product
of months of research, development and

Vestibular Screening of Astronauts Urged

By Carl Breaslow

Painful means of detecting and weeding out or saving space flight candidates with a marked susceptibility toward vestibular disorientation during flight, such as those experienced by Soviet Cosmonauts Mir, Gherman Titov, are under urgent study in both the Soviet Union and the United States.

Lack of any feeling of motion as visual orientation at the part of Major Andrian Nikolayev and Lt Col Gori Ponomarenko probably accounts for the Soviet's painful mistake in launching for the two IAU Oct. 8, p. 381 ones help in solving this susceptibility, although some scientists apparently feel it can be largely a matter of individual resistance to the phenomena.

Planetary Measurements

Mercury, Venus, Mars—Earth's twin sister will participate in a new sounding rocket program aimed at making orbital and ultraviolet measurements of the planets. Mercury and Venus and Jupiter during these periods of peak brightness in the next several years.

Full details of the programs and exact directions of the flights will be determined by a joint National Aeronautics and Space Administration, Goddard Space Flight Center, layer not been settled. Launch vehicles, however, are expected to be either the atmospheric reentry Aerobee 150 or 150 rocket-capsules of carrying 120 lb payloads to altitudes of 100 and 200 km, respectively.

Two-stage plans will be sought during peak intensity of the planet.

- Jupiter—October 1964, and November, 1964
- Mars—February, 1965, and March, 1965

- Venus—May, 1964, and July, 1964

Atmospheric profiles will provide data on the atmospheric winds which will be helpful by the month's newly organized Space Sciences Division, headed by Charles Sonett, who transferred here two months ago from NASA headquarters in Washington.

The solar profiles will be launched either from Wallops Island or White Sands Proving Ground to make observations of the temperature and pressure of the planetary atmospheres.

Experts in this field among the approximately 100 delegates here for an international symposium on "Basic Environmental Problems of Man in Space" all agreed, however, with Dr Arthur Guybrush, of the U. S. Naval School of Aviation Medicine, that "in space travel it is essential that no man be sent into space who will experience vestibular-induced sickness."

A paper presented at the symposium by Soviet instrumentation scientists M. D. Rostovtsev and E. M. Yagodkin and their associates probably reads from "disturbances in the physiological functions of the nervous mechanism preventing the perception of space." Their opinion, they had, has been confirmed largely by experimental investigations they have conducted concerning the etiology of visual, vestibular and motor mechanisms and of the appearance of spatial illusions."

Glen Feat Denied

Graham denied any such knowledge and, on conviction, Dr. S. C. White, of the National Aeronautics and Space Administration's Medical Support Center, and his team found that he also was guilty of an air raid violation.

Graham explained that Glenn had suffered an infarction of unknown cause during flight but after landing he did experience "some stomach cramps" during his stay in the water before recovery and afterwards aboard the recovery destroyer. This feeling, "which didn't bother him very much," disappeared when Glenn arrived at the rescue ship dock, of an aircraft carrier, Graham said.

Ranger Schedule

Ranger 6, first of at least four Ranger spacecraft which will carry optical television cameras consisting of a pack of six television cameras for obtaining high-resolution photographs of the lunar surface before the spacecraft ends its life, will be launched from Cape Canaveral, probably between Jan. 15 and 20.

Ranger 7, another spacecraft on the same mission, will follow in March; Ranger 8 is the spring-possible on May; and Ranger 9 is late summer (IAW Oct. 8, p. 381).

In effect, which reached off new sources and areas of research in both the U. S. and USSR, was mentioned directly by Dr Guybrush. He and the Soviet astronauts apparently sustained a "shamefaced silence" during their interview with a state of heightened tension, feeling immediately disconcerted at though her body were in a vulnerable position.

During the seventh orbit, Guybrush

enveloped, after Titov had taken over manual control of the Vostok, on the sixth and last, owing the capsule through a series of left, right and complete turns, the astronaut suffered periods of dizziness and nausea.

"It would be a mistake of superstition," he said, to know whether Titov's way be natural or whether it is due to vestibular disease. He added that the "greatest hazard" was what Soviet scientists have told that this might be the case.

A member of the Bauman delegation said it is as yet undetermined that U. S. astronaut Major Lt Col John Glenn had, but "fainted" during his ultraviolet flight and stated "how long did that remain?" because of the short duration of the mission.

White added that Glenn "suffered disorientation during an orientation test" during flight and had, in fact, "not felt" his shower. This, he said, extended in the point where Glenn experienced no feeling of hunger.

Predicting susceptibility to vestibular sickness prior to a particular flight, Guybrush said, since it is impossible to simulate weightlessness in any way, except under terrestrial conditions. He adds, however, that "there is great evidence that susceptibility to motion in our type of gravitational environment even amongst our positive side for exposure to another type."

It is almost a truism, he said, that "all motion sickness is vestibular sickness, but some vestibular sickness is not motion sickness."

Studies conducted thus far by the Naval School of Aviation Medicine indicate that motion sickness begins with the expectative coupling between normal and deaf subjects. The motion tests were conducted primarily at a slanting angle of 15°, a configuration of an aircraft located in Tauranga, Canada, and aboard aircraft in flight.

Thus experiments, though for human complete, indicate that persons with labyrinthine defects are relatively insusceptible to physical results and liable to susceptibility attacks, which may come symptoms of healthy subjects."

Tire Tire Resistance

He also noted that tire prints can easily be made to give a greater assistance from normal to vestibular disturbances and suggested that this may indicate an ability to adapt one's system to a particular motion in motion, said, and now, the problem can best be solved in terms of motion rather than motion.

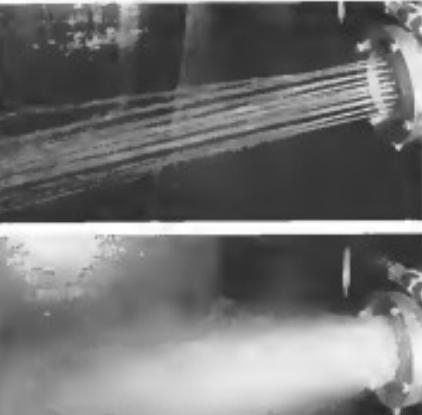
He warned, however, that adaptation may be highly ineffective in nature. In the tests, he found that if a subject could not overcome adapt to one type of head motion but not to a different. At times, the adjustment to one type of motion made the subject more susceptible to others.

Graham concluded that so long as astronauts are selected from pilot groups with a large measure of flying hours, "the closest approximation" eliminates those with more than a small amount of flight time.

A bigger problem, he added, will come in the selection of astronauts with little or no previous flying experience to participate in ultraviolet flights.

W. S. Lovelace II of the Lovelace Foundation for Medical Education and Research, which placed a major role in selection of the Mercury astronauts and scientists will need to undergo a selection of one year's worth training before flight, he added.

To give their recommendation and selection, these men will use three basic



Standard Injection, Aeration Throttling Compared

Concentrated propellant injection (CPI) is compared with United Technology Corp.'s aerosol throttling system (ATS), which the company has tested in about 100 hot flights (IAW No. 3, p. 20). UTC developed a device to droplet-injection for injecting an inert gas into manifold to same propellant injection-to 10% of operating valve and still maintain combustion stability. Aerousl throttling system has been tested for Apollo low-pressure engine and quasi-stationary use.

Exposure to the strains of flight as they function in such systems will be important to such systems as the selection process will be more difficult. The Centaur program will be more helpful in the kind selection, indoctrination and training of astronauts in case they can go along an orbital flight with an experienced astronaut."

Report delivered by Dan McElroy, head of the U. S. Air Force's hypersonics research program and a research consultant at Wright-Patterson, and co-authored by W. Ben Adey, of the University of California's Space Biology Laboratory, suggested that "in general, the selection of a flight crew of astronauts for the mounting of the Centaur program will be considerably easier than the conventional 'experience preference' approach to the problem."

The number of basic structural activities required by the crew should, if possible, avoid any direct attachment to the cabin as adequate electrodes, and, in particular, should avoid the practice of having the crew lay down or sit inside the cabin. It should be compatible with any survival equipment, and upthrust should be minimized."

Studies made by a number of universities by the two scientists also indicate that prolonged periods of weightlessness may produce a "major reduction in accuracy rates" from vehicle and probe experiments in prolonged weightlessness but that "approximately normal accuracy will occur" in the astronauts'



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military, naval and aerospace acquisition procurement. Further efforts related to the selection of military allies, the report said, "was therefore be expected to occur at quite early under exceptional circumstances."

The sixth recommendation might be prolonged absence of light and the measure of existing as an assessment of total darkness for a prolonged period of time.

To test the possible effects of this condition, Fleckinger and Adair caused a series of six drivers and passengers to remain in their cars for 10 minutes at a time, without seeing from shortly after birth for periods exceeding three hours in some instances.

Monkey Experiments

These animals, the report added, "appear to sleep very little and display in most cases a circadian activity, with constant grooming and pecking at objects in the environment. They exhibit bizarre and distorted behavior patterns, with scratching of their own backs, chewing of their own hands and whistling movements of both ears actively displayed in continuous activities, such as grooming. Eating food such as a banana can be interrupted by violent hand shaking from the monkey with grooming motions resembling a dog."

These and other tests also indicate that hallucinations can occur, with the test subject seeing and cleaving at various objects. The report said that "whether the degree of sensory reduction in the space environment, even if prolonged, can result in a threshold level, remains to be determined."

Accelerated Research

Dr. Lovelace, in his report, made a plea for an "accelerated research program on an international basis" to accelerate research and development programs to handle the next challenge in such a combined manner that occurs in the space environment.

He said that these thresholds of performance degradation in man should come under study.

- * Degradation from low performance.
- * Gross degradation with reversible tissue damage.

* Short and long-time degradation with irreversibly tissue damage.

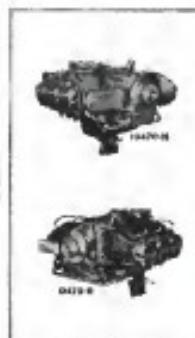
Lovelace also suggested the establishment of an International Scientific Advisory Council comprising the various clinical and scientific disciplines for overseeing, updating, knowledge and evaluating the progress and future requirements of all research concerned in communication and selection of instruments, type of patients with disease or injury while in space, the effect of angle and combined stresses in space, with particular respect to performance degradation of the crew.

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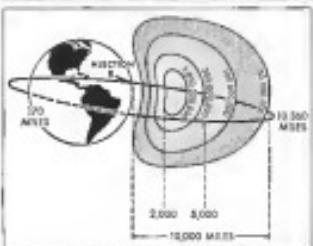
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Explorer Studies Earth's Artificial Radiation Belts

At left, technicians check out Explorer 35, which was successfully launched from Cape Canaveral, Fla., Oct. 27. The satellite was launched by a three-stage Thor Delta vehicle. Principal experiments aboard the 95-lb. satellite were an electron energy distribution device, electron and proton concentration detectors, electron angular distribution detectors, and electron density detectors. The satellite is transmitting useful data although its high-gain tape appeared to be severely affecting some of the satellite's functions (AW Nov. 5, p. 42). Bottom photo shows SIRI photographed as a candidate space instrument.



Missions of Explorer 35 is to study the artificial radiation belt caused by high-latitude nuclear oval that was the Pacific test July 9. Satellite program is 1957 no. 30, page 10,661. Figures on right are from NASA program.



University Space Support Role Expands

By Warren G. Wetmore

CHANGE—Dependence on universities to provide manpower and fundamental research for the U.S. space program is along a new relationship between the government and college, according to Dr. George Weisz Brode, president of the University of Chicago.

Brode's remarks served as keynote for the university viewpoint at the first National Aerospace and Space Administration-University Conference on the Sciences and Technology of Space Exploration held (AW Nov. 32, p. 26).

Purpose of the conference was to stimulate public administration and industry to better meet the needs of basic research and better train students to meet internal goals in the exploration of space. NASA had about 500 top-flight training and science graduate level jobs and will increase that number next year to fill its expanding needs.

Brode praised NASA's efforts and policies in its programs with the universities, but referred to the continuing academic malaise about the value of some aspects of the space program, particularly Project Apollo.

Speaking of funding that runs in the excess, he said, "there are many people in academic institutions who wonder, 'Should we do this, or would it be better to do something else?' I think that is certainly a debatable point."

Research Support

Role of the government in supporting basic research and providing laboratory facilities is noticeably growing, Brode said. Only the government can afford the large sum of money required for expensive facilities and equipment, he added.

He also pointed out that economists, social scientists and humanists want of facilities and instruments, too, nevertheless, will need to make their proposals plausible enough to win the support of Congress.

Brode stressed the necessity of developing more effective lines of communication between the three corners of the scientific triangle—government, industry and academic institutions, as well as better means of collaboration and communication within the academic community.

The latter, he said, is being accomplished by the 32 colleges and universities in the Associated Member Universities, an organization created to advise the nuclear research facilities of the Argonne National Laboratories in Illinois. More cooperative laboratories of that type are necessary, since no single

institution could afford the facilities that would be available to it in a privately-operated institution, Brode said.

While commentary from delegates on the NASA program of universities segment was largely favorable, there were some reservations. One delegate felt that in making this grant the government would inadvertently warp a measure of the universities' traditional freedom. He also complained that the emphasis on space is disproportionate, and that the field is getting the best university graduates in science and engineering in the overall distribution of talent in space fields.

Another delegate found that, with budget cuts being made, the more available, the quality of research must suffer and that some worthwhile projects would be forced due to the increased work load of NASA contract workers. Research contracts can, however, as academic status would, be lost, and university administrators are often more concerned with whether the research is sponsored, rather than with the scientific value of the investigation.

In another session, the delegates were told that space exploration will cause a reevaluation of the various academic disciplines and a firm move from specialization. Dr. Robert Johnson, director

of NASA's Institute for Space Studies in New York, said that some of its fundamental tasks, physics probably the most serious of students who go into space science, but that there could be more emphasis on such subjects as astrophysics for planet imaging and on atmospheric physics in the earth sciences.

It would be a mistake to create independent space science departments, he said, and young students should feel free the basic, traditional concepts.

Interdepartmental Committees

The solution, Johnson said, can be found in the creation of interdepartmental committees, where decision would be by diverse interests and joint concern of study for those interested in space sciences.

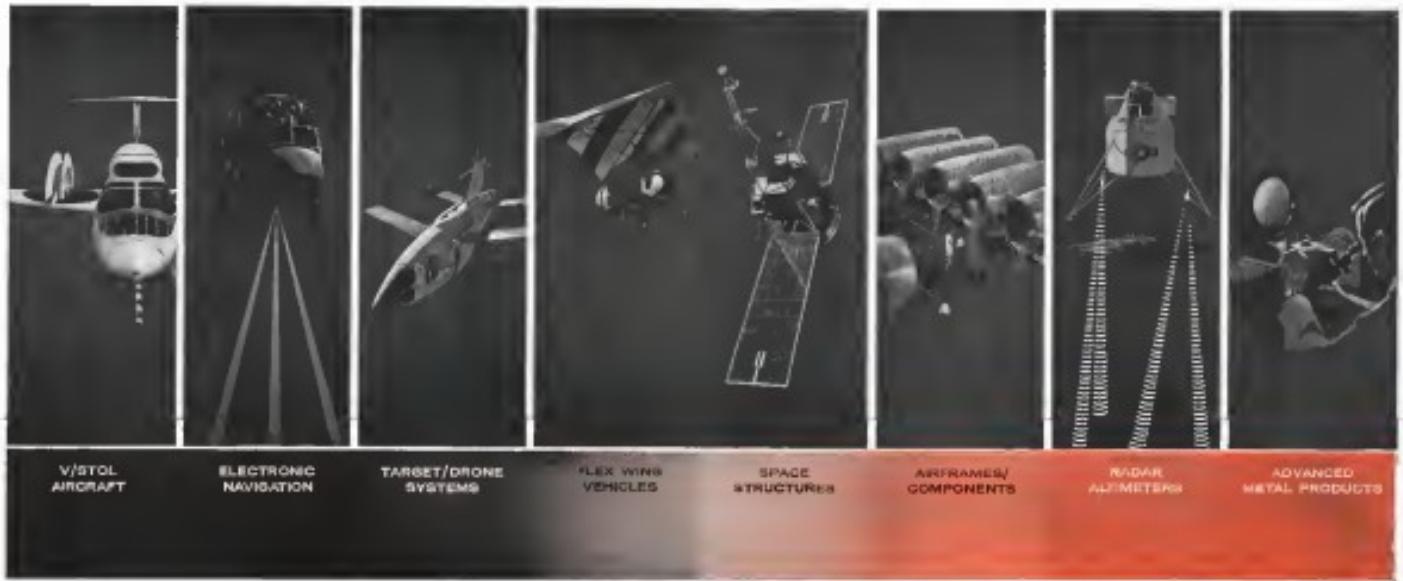
Concern in space physics, for example, could be shared along traditional lines but with strong emphasis on non-disruptive advances. Such progress, he said, would provide a broad base for future development.

Dr. Thomas L. G. Smith, director of NASA's Office of Grants and Research Contracts, said that in addition to project-type awards, the total dollar value of which has doubled each year since NASA was organized in 1958 and probably will more than double in fiscal



Satellite Communications Relay Antenna Developed

Lightweight apertured paraboloid-horn-type high-gain antenna has been developed by Space-General Corp. for use on satellites for relaying communications between space craft or interplanetary flights and earth stations. Array has two sets of three orthogonally mounted apertures powerful enough to receive intensity of signals from space craft and relay them to earth. Antennas system would automatically point toward transmission source while tracking signals, company says.



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These notable breakthroughs by Ryan scientist-engineer teams, demonstrate proven capability to create the necessary technology and to manage every phase of new, complex systems.

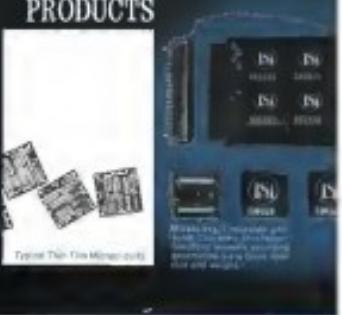
- Design, build and fly the world's first jet VTOL airplane. Then apply over three million man-hours of VTOL experience to creating such modern aircraft as the Army's VZ-2 Pave Hawk aircraft.
- Take a concept like the Breguet wing and develop a successful test-bed vehicle with broad applications—the Ryan Flex Wing.
- Pioneer the CW Doppler principle into world leadership in the production of electronic navigation systems for all types of aircraft now flying or projected.
- Develop reliable jet target systems like the famed Ryan Firebee—most widely used target jet in the free world.
- Design and fabricate radar altimeters, precision antennas and space structures for such advanced space vehicles as Mariner II, Surveyor, Voyager.

From advanced electronics to the fabrication of space age metals, Ryan is prepared to assist government and industry in early studies, design, development, production, and the field support of complete operational systems and equipment.

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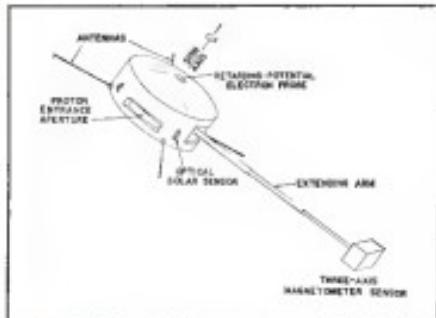
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ADVANCED THIN FILM MICROCIRCUITRY PROVIDES NEW DIMENSIONS FOR LSI INSTRUMENT DIVISION PRODUCTS



The Task: To provide the aerospace industry highly reliable, miniaturized electronic systems and components utilizing economic, mass produced thin film microcircuitry.

The Solution: A new, semi-automatic high vacuum deposition system developed by LSI for volume production of thin film microcircuitry, now in full scale operation at the Instrument Division. This highly precise production technique, coupled with a unique ability for extreme accuracy in the layout of electronic circuits, offers great flexibility in the design of Instrument Division electronic systems since it combines significant miniaturization with unusual performance and reliability characteristics. Instrument Division customers are being provided products with the many benefits which this unique microcircuitry production process affords, including substantial size and weight reduction, as well as greatly increased performance, reliability and extensive environmental characteristics. This is a portion of the LSI Instrument Division's continuing program to provide the next generation of aerospace guidance and control equipment, as fast or faster than requirements become known.



USAF to Study Solar Winds

Proposed to study attributes of solar winds and earth's magnetic field and determine detection of field by ion plams will be launched on Air Force/Chevron Wright Blue Scout Payload developed at USAF Special Weapons Center, New Mexico will have one appendage to earth's magnetic field, with optical solar arrays supporting all measurements and telemetry transmission. Complete telemetry time is required every 1/2 of a revolution of experiment.

PRO—NASA has estimated recently the Postdoctoral University Program to "improve significantly the university participation in space science and technology and complement the expanded research interests of NASA."

University program includes the following:

- Training grants (AW July 3, p. 157) will increase the future supply of postdoctoral released personnel engaged in specialized science and technology.
- Fellowship grants (AW Oct. 1, p. 17) to young doctors, including necessary for their research.
- Special-purpose research grants to strengthen academic institutions and permit them to receive support of NASA programs through encouragement of creative investigation in scientific disciplines, and to develop new capabilities and greater controllability of activities and stabilization of funding.

Hopewell Shuts Down

From NASA concern is the impending closure of highly-touted nuclear power plant, said state, and more than three thousand will be engaged in space-related efforts. NASA plans to accelerate the production of domestic hydrogen both nuclear and engineering fields.

Under this phase of the program, the university receives a training grant and thus selects the tasks. This would,

result in no reasonable expense incurred in training grants.

Initial program, started in September last year, p. 175), involves 10 students at each of 10 universities. A polyphased increase in the program is planned for the next academic year, with the inclusion of an additional 400 to 750 postdoctoral students, Small told the delegates.

Laboratory Shortage

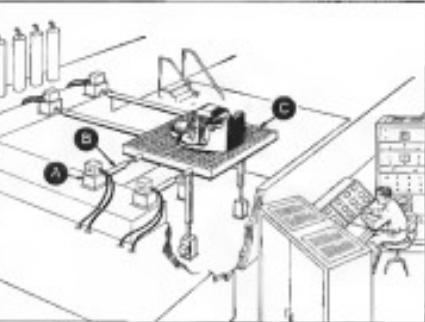
In carrying out the activities, NASA is using the need for alleviating the acute shortage of laboratory space in the universities.

Growth will be made to academic institutions and to non-profit research organizations to purchase or build additional facilities by means of space-related science and engineering.

Dollar value of these facilities grants will be determined by NASA, and may be as much as the full cost of the proposed structure. The title to a laboratory or other research facility will be vested in the government, unless the NASA administrator determines that the academic space program will be served best by transferring the title to the grants.

Small said that the first grants under the program were awarded in September to five universities, and that no facilities were turned over to the recipients.

Special-purpose grants—designed to help the universities help themselves—will be made to incentive competition



Six-Degree-of-Motion Astronaut Trainer

MB Electronics will build six-degree-of-motion astronaut training simulator at Wright-Patterson AFB, Ohio, under USAF NASA contract. Components shown in drawing include hydraulic tanks (B) which store pressurized and aerosol gases (H) to inflate magazine test platforms (C). Simulator will accommodate 2,000 lb. load and induce rotations up to 10 cps and pitch as high as 20°.



A report on economical shorter-haul power



Prototype JT8D being proved tested at Boeing with actual outer fairing and cowl to be used in the three-engine Boeing 727. Lightweight JT8D develops 14,000 pounds thrust.



JT8D met all FAAC certainties in tests at the Milwaukee Turbine Engine Test Facility. JT8D ran 460 hours at 25,000 to 35,000 feet at 0.8 Mach, and various temperature conditions.

JT8D begins FAA certification tests

Pratt & Whitney Aircraft's new JT8D turbofan has begun Federal Aviation Agency tests that will lead to certification of the engine for commercial airline operation. Significant portions of these tests are already completed.

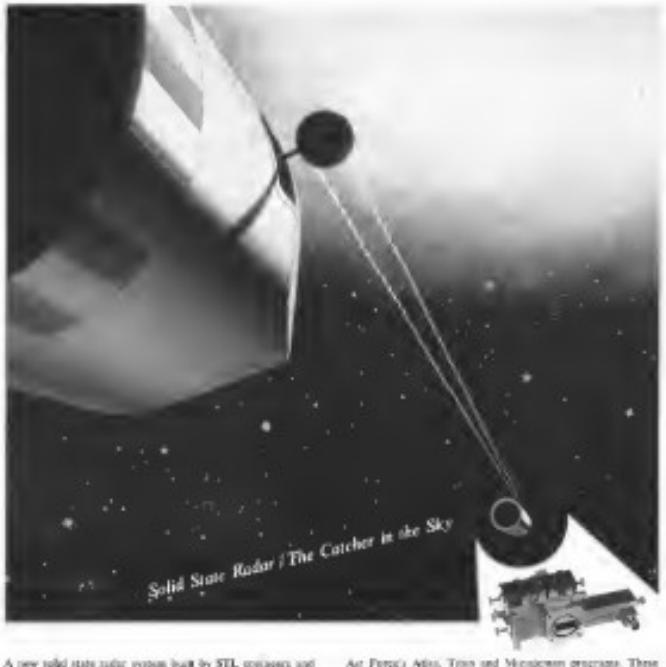
The tests should be completed early in 1963, when Boeing's 727 short/medium-range jet transport begins flying. The 727 will be powered by three of the 14,000-pound-thrust JT8D engines.

- JT8D development testing began in 1961. Since then, the engine has:
- Completed more than 4,700 hours testing, including 1,000 hours of endurance in accordance with the FAAs 150-hour test schedule.
 - Completed six company 150-hour endurance tests.
 - Lagged more than 60 hours in flying test hours.
 - Equaled or bettered all specifications in altitude thrust specific fuel consumption.

Seven JT8Ds have already been delivered. These advanced powerplants will help the 727 operate from 5,000-foot runways and economically fly 70 to 114 passengers over routes of 150 to 1,500 miles.

**Pratt &
Whitney
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A
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DETROIT 14, MICHIGAN



A new solid state radar system built by STL engineers and scientists can send out and receive signals at X-band frequencies to help map continents and dock vehicles in space. STELATRAC is its name. It is the first solid state system of its kind. The X-band transceiver is shown above. It has successfully passed temperature and vibration tests. STELATRAC can also be used as a command link between vehicles in flight. By changing its module design, the flexible radar system operates as an altimeter and doppler velocity sensor to probe spacecraft safely to the surface of the moon and planets. Today STL is busy on many such projects as STELATRAC. STL is also prime contractor for NASA's OGO and a new series of classified spacecraft for Air Force-ARPA. And STL continues Systems Management for the

Air Force's Atlas, Titan and Minuteman programs. These scientists enjoy immediate exposure in Theoretical Physics • Systems Engineering • Radar Systems • Experimental Physics • Applied Mathematics • Space Communications • Antennas and Microwaves • Sterilized Coupling • Assisting Computers • Solid State Physics • Computer Design • Telecommunications • Space Physics • Digital Computers • Coaxials & Navigation • Electromechanical Devices • Engineering Mechanics • Aerodynamics • Propulsion Systems. For Southern California or Cape Canaveral positions, write Dr. R. C. Pettit, Department A14, One Space Park, Redondo Beach, California, or Box 4277, Patrick AFB, Florida. Your inquiry will receive a prompt reply. STL is an equal opportunity employer.



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or more where research activity is needed.

Stoll added that these grants may be used to conduct related minor projects whose support cannot be given in whole, thus lessening the impact of funding fluctuations.

Special Funding

Special funding method will be used for university program grants to stabilize program activities over several years. The method-known as annual funding—will entail three-year grant, which provides 100% funding for the desired level of effort during the first year, two-thirds during the second and one-third during the third year of the program.

This money is set aside and then paid according to a prearranged schedule.

The project is reviewed annually and NASA decides to continue its support and supporting funds as appropriated by Congress. The grant will be supplemented each year to bring it up to the agreed level of effort for that year.

Thus, if support is terminated for some reason, the universities will have funds coming for another two years and will be able to discharge their obligations if they have accrued an enough time with the program.

NASA Guidelines

NASA's guidelines for this program represent the most liberal approach ever made by the government in working with the universities to accomplish a specific mission, Stoll noted. "As long as universities demonstrate that they are able to carry on these activities as a creative and responsible manner," he said, "these guidelines will remain broad."

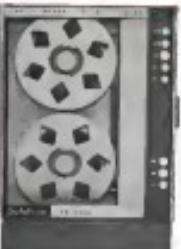
Dr. Hugh E. Dryden, NASA deputy administrator, emphasized the agency's desire to work with the ranking faculty of the universities in the course of conducting studies and research in

Training Grants

Washington—Two universities have received training grants for the support of ten doctoral candidates each in space sciences and engineering.

Grants, which are a part of NASA's newly-created Satellite University Program, were awarded to Worcester Polytechnic Institute, University of Maryland, Georgia Institute of Technology, University of Michigan, University of Chicago, University of Massachusetts, State University of New York at Stony Brook, and Michigan College, Rice University and University of California at Los Angeles.

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CEC's New Wide-Band Magnetic Tape Recorder/Reproducer Systems give you twice the capacity of information storage as conventional machines. Bandwidth: 100 cycles to 20kc, direct—P to 20 kc, FM 6 spots. Solid state throughout for low power consumption and weight. Type VR-3020 is the portable model and Type VR-2020 is ideal for data gathering in lab, van, shipboard and warehouse environments. For complete information and specifications call your nearby CEC office or write for Bulletin CEC-280-X18 and 290-X11.

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APOLLO SUIT

The first integrated space-suit assemblies will be developed by Hamilton Standard for Project Apollo, under contract to NASA. They will provide comfort and mobility for astronauts outside the craft in deep space and on lunar exploratory missions. Hamilton Standard, as prime contractor, will manage the program, and design and build life support packs. The packs must supply oxygen and pressurization and control temperature, humidity and contaminants. Subcontractor for the suits will be International Latex Corporation.

The space-suit project, an important portion of Hamilton Standard's life support program, applies diversified experience in hydraulics, pneumatics, mechanics, electronics, and packaging. Hamilton Standard blends and develops these basic technologies to achieve an integrated systems approach to life support equipment.

**Hamilton
Standard**
DIVISION OF UNITED AIRCRAFT CORPORATION
WINDSOR Locks, Connecticut



Radiation Detector

Developed by General Electric, it is designed for monitoring from helicopter to detect radiation levels in nuclear test areas. Recording life of radioactive source is a period of approximately 10 days.

Space technology. NASA does not want to create independent contractors anyway which tends to distort the astronauts' preference from the beginning in the participation of his research.

"It has been estimated that by 1970 at least one-fourth of the nation's raised scientific and engineering manpower will be engaged in space activities," Dryden said. "The university alone is the producer of this talent and, like the logger who has a responsibility for felling the tree before the time he has cut it, NASA, as a user of university-trained talent, has an obligation now to let their state of the art of applying the resources demanded."

Program Goal

University programs, he said, are in a good position of about 4,000 doctoral candidates at 150 universities, and will yield 1,000 new PhDs in aerospace fields annually.

Dr. Dryden said that \$10 million of fiscal 1962 NASA funds was given to academic institutions, of which \$25 million was in support of graduate students. The academic research grants totaled about \$31 million. Research grants approached \$5 million, and totaling grants \$2 million. Estimates for fiscal 1963 show an increase in the total university program, including grants, to about \$65 million.

Nor all NASA executives are in full support of the Sustaining University Program. One high official privately voiced criticism of NASA's direct involvement in the program, stating that it is beyond the intended scope of NASA's mission of research and space flight services.

He added that if the program must be addressed, better by the National Science Foundation, in keeping with its traditional role as support of academic research and graduate studies in research and engineering.

Subcommittee Urges Strong Single Manager for New Advent Program

Washington—House Space Sciences Subcommittee has favored the move to consolidate under the Army the parts of the Advent—intercontinental missile project and recommended the appointment of "a strong single manager" at Dept. of Defense level to keep the same thing from happening in the restricted program (AW, June 25, p. 32).

The subcommittee, in a report it past, said there was "little or no evidence of a spirit of cooperation between the Army and the Air Force in the Advent program." It said this is in error. "The nation has very little to gain" from the two services if it has spent \$1 billion for other. The report also said the director of Defense Research and Engineering (DR&E) might have supervised the Advent project more closely.

DR&E was an overall charge of Advent when the Army was project manager, and is playing the same role now that Air Force is the program manager. The subcommittee said it agreed with Gen. Joseph W. Johnson, Army project manager for Advent, who said the only way to do the job efficiently was through a strong manager with authority to end several service lines.

The subcommittee reported the idea that it would be better to have one military service, or civilian agency of the government, to make effectively and consistently a post-nuclear displacement program. Clearly, a single manager endorsed well both responsibility and authority in the most effective manner.



X-20 Nose Cap Materials Tested

Materials for Boeing X-20 (DynStar) space glider nose cap undergo high temperature test as ground test article passes more than 4,000°F over period up to Oct. 1962. Rig was built by Long Beach-Vinylite, utilizes 30 welding torches heating super-pressure gun nozzle. Zincous dioxide speeds heat over specimens in hostile testility conditions.

"VARIABLE THRUST CONTROL BY AERATION"

UTC DEVELOPMENT CONTROLS THRUST OVER 1-TO-100 RANGE !

STATE-OF-THE-ART ADVANCEMENT—United Technology Corporation takes pride in announcing what may be one of the most important liquid rocket propulsion technology developments in this decade: variable thrust control over a range of 1-to-100. This company-sponsored development can provide up per stage liquid rocket motors with the levels of operational flexibility demanded for rendezvous, docking, and soft landing missions. UTC's new aerated thrust motor will permit a spacecraft to hover, translate, and reorient with a maximum degree of precision and control.

COMBUSTION STABILITY—UTC's variable thrust control system is a model of simplicity. An inert gas is injected into the propellant just before it enters the thrust chamber. A series of linked valves controls the propellant/gas mixture, permitting the effective density of the propellant to be varied over a wide range and provide any desired thrust level. Gas may be taken from the same source used to pressurize propellant flow. This new technique provides UTC's rocket motors with a degree of combustion stability never before accomplished by any thrust control system.

IMPROVED MOTOR PERFORMANCE—Hot firing tests of this UTC propulsion device indicate that motor efficiency is improved to 95% of theoretical Isp. Motor life is prolonged, since the aeration technique prevents unbalanced combustion, channeling, and erosion of thrust chamber walls. The possibility of explosion during motor firing is almost completely eliminated. The safety, reliability, and flexibility of UTC's new system of variable thrust control by aeration make it a strong candidate for use in lunar excursion missions, orbital revision, or module-to-mothership docking.



United Technology Corporation

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Reentry Protection System
Systems Engineering Corp., Rockville, Md.—\$450,000 for technology research on reentry protection system for the space shuttle orbiter. The work will cover all of the basic and solid-state technology needed to develop and demonstrate a system for the shuttle orbiter.

Aerospace Research Corp., Research Triangle Park, N.C.—\$250,000 for development of a 2.25-MHz transponder module based on microcircuit technology. The unit is to be used for ground-based communications and problem diagnosis, switching systems for the shuttle orbiter. The \$1.5-million contract is for the first year of a five-year program.

Boeing Aerospace Co., Los Angeles, Calif.—\$175,000 for feasibility studies of a reusable anti-ballistic missile system for intercepting and destroying ICBM warheads.

Boeing Aerospace Co., Seattle, Wash.—\$150,000 for development of a reusable anti-ballistic missile system for intercepting and destroying ICBM warheads.

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Mercury Landing System

Foilback model of Mercury spacecraft designed for one-day return flights under positive airlock using from C-170 transport to qualification test of quaternary landing system developed by Northrop Vought Space Systems that will also be used with second stage space boosters.

NASA Contracts

National Aeronautics and Space Adm. Instrument Contracts Awarded the following contracts and research grants:

NATIONAL AIRPORT FACILITY CENTER, RALEIGH, N.C.

General Dynamics Corp., Falls Church, Va.—\$1.1 million for design, development, and acquisition of a ground-based navigation and tracking system for the space shuttle.

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New Shapes Proposed for Higher-Velocity Re-entry

New shapes for future reentry vehicles, designed to penetrate earth's atmosphere at lower stage velocities after being an interplanetary missile, have been developed by Ames Research Center of National Aeronautics and Space Administration. Closer to high velocity than conventional blunt shapes, they were found to reduce heating which increases radically at higher re-entry velocities. Proposed vehicles would use oblique entry. Case of a right-angled cone of left and hyperbolic nose-pieces had showed skin-gated point was needed to retain control shapes during reentry. Conical nose retains shape by feeding air into it through open hole to offset difference between dihedral rates of the cone apex and the sides of the cone.

Throughout the world—



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In the final analysis, throughout the world, Lucas fuel pumps give outstanding performance. Over 100,000 of these fuel pumps are in operation in today's civil and military aircraft. The civil pumps have accumulated a total of 10,000,000 hours' service. In many instances, Lucas pumps on the North American continent are plowing over 3000 hours' service between overhauls. Proof, then, that from the tremendous care Lucas takes in the manufacture of these pumps, stems the achievement of world-wide confidence.

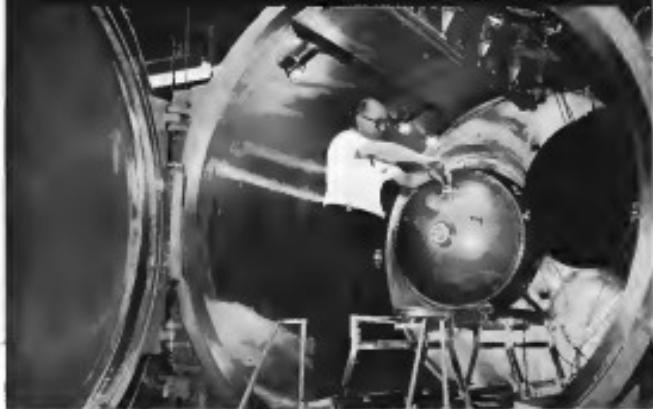
Lucas Gas Turbine Equipment Limited, Birmingham, England.
 Lucas-Rexon Limited, Terrebonne, Montreal, and Vancouver, Canada.
 Los Angeles and New York, U.S.A.;
 Lucas-Rexon (Australia) Pty. Limited, Melbourne and Sydney, Australia.

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"WORKHORSE" FOR GODDARD'S ENVIRONMENTAL TESTING



The 210-foot-diameter Environmental Measurement 2129 or 240 reflectometer being used in aerospace space environmental testing in the 50 states (except Alaska) and Puerto Rico.

The Goddard "8 by 8" (8 ft. in diameter and 8 ft. long) horizontal test chamber is one of the key elements in the reliability testing program at NASA's Goddard Space Flight Center, Greenbelt, Maryland.

This Stokes-designed and Stokes-built thermal-vacuum unit was the first true space simulation facility installed at Goddard for testing uncrewed vehicles under the harshest possible range of environmental conditions and is the largest assembly in use there. It has a vacuum capability of 1×10^{-9} Torr (300-mile altitude) under full load conditions, and is equipped with a heat transfer system capable of handling radiant wall temperatures from -65°C to 300°C .

Goddard's "8 by 8" will continue to serve as the backbone for the Space Flight Center's highly advanced reliability testing programs until the new test facility and two horizontal laboratories now under construction go into service early in 1965. Major space test chambers of this facility, which is expected to set the most advanced standards for spacecraft check-out, are two 36-ft. diameter, 80% high thermal-vacuum environmental simulation bakesets selected as a prime contractor to NASA for complete vacuum and cryogenic systems for these huge chambers.

We welcome your inquiries regarding our capabilities and facilities for designing, fabricating, and erecting environmental facilities well in advance of the state-of-the-art, in every portion of a satellite project requiring high-vacuum and cryogenic systems. Space Systems Department, P. O. Stokes Corporation, 5306 Baker Road, Philadelphia 30, Pa.

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PRODUCTION BRIEFING

Boeing Co.'s Vertol Division has been awarded an \$18,475,123 Navy follow-on contract for production of additional CH-46 Sea Knight assault transport helicopters (Navy Oct. 22, p. 32) for the Marine Corps.

J. B. McRae, Inc., Atlanta, Calif., has secured a contract from Space General Corp., El Monte, Calif., to build three gyroscopic motion picture cameras to record deployment and recovery operations of National Aerospace and Space Administration's inflatable microsatellite payload (IMP). An Arrow II rocket is scheduled to boost the package about early next year (AVW Oct. 8, p. 32).

Bell Helicopter Co. has been awarded a \$15 million Army contract for production of UH-1B and UH-1D helicopters. Contract is worth funding for Army's Fiscal 1965 budget, which is expected to total \$75 million for 219 UH-1Bs and 121 UH-1Ds.

Rohr Corp. has received follow-on contracts totaling \$15 million from Boeing Co. for production of gimbals on gas pads, struts and shrouds for Air Force KC-135s and C-135s.

Fairchild-Stokes Corp. will continue development of its AN/HSQ-5 audio-visual communication system under a \$1.5-million contract from Army's Electronics Command. Contract will cover development of the jet phone, now in production, flight test stage, research flight demonstration. The HSQ-5 which covers a variety of electronic operating systems, is a mid-length launched from a trailer bed.

Linton Industries' Arm Service Corp., Pittsburgh, Pa., will build seven new, larger vacuum tanks under a \$1,523,800 flight simulation contract. Units will be constructed to mate and connect in parallel to reflect light in the same proportion as several man-sized reflectors of man energy.

Tenneco Instruments, Inc.'s Metal and Composite Division has received a \$166,000 contract from Air Force's Acoustics and Systems Division to evaluate existing techniques for producing inflation with aluminum foil and to define optimum manufacturing procedures.

Space-General Corp., El Monte, Calif., will modify company-developed guidance subsystem under a \$144,000 contract for NASA's Project Vesta Modification. It consists of design, development and test of a system to stabilize and control launch vehicle upper stage payload combinations.

ACTION MEMO
Design Engineering

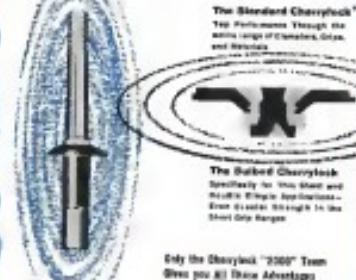
FROM: *J.M.K.*

Dept. 41-A

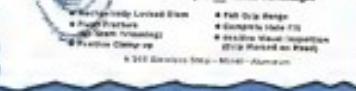
I understand Cherry can support all the claims they make in this ad—if so, we should be using the Cherrylock Set's get an evaluation going immediately
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see page 22



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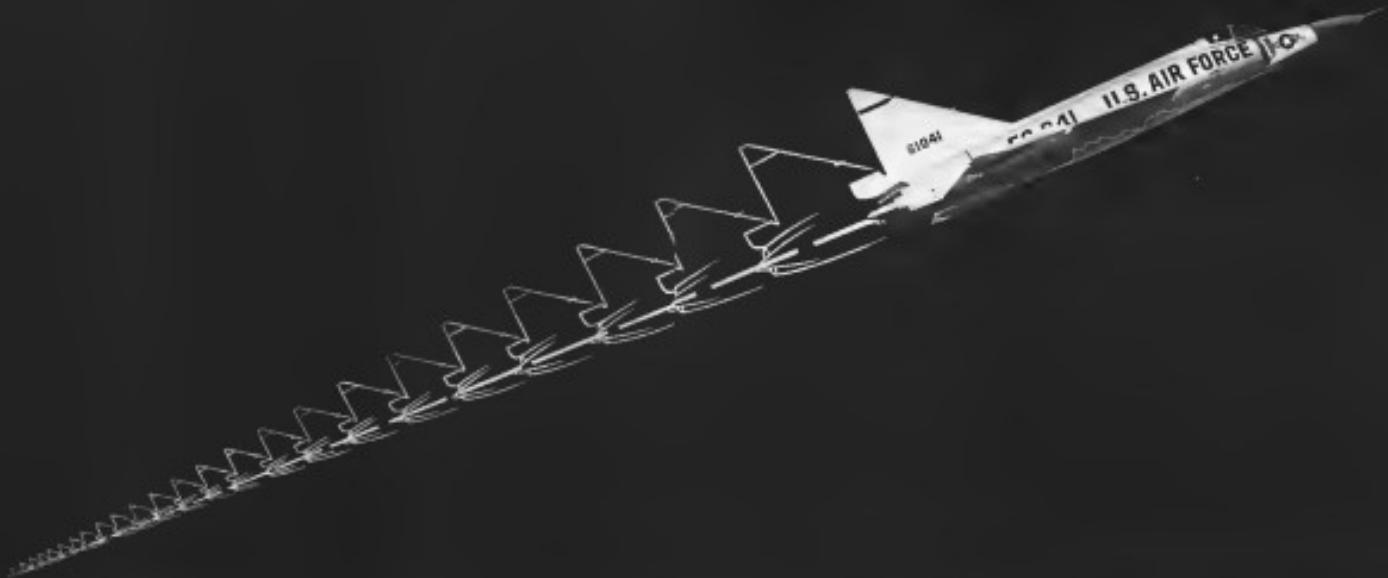
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Aeronautical Systems Division, our sampled-data system has undergone intensive analog computer studies using a variety of vehicle characteristics including the B-58 and Dyna-Sear. But most important of all, it has flown and flown successfully on an Air Force F-102 over a range of sub- and supersonic speeds.

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Above: Two Chance-Vought F8U-2NE Crusader jet fighters in formation. Below: The single-seat fighter is shown in an evasive flight mode with two Sidewinder R-3 missiles and eight Zuni air-to-ground rockets carried in pods.

F8U-2NE Evaluated for Fighter-Bomber Role



Above: F8U, which has maximum speed of approximately Mach 2, carries 30 Zuni rockets in wing pods. In flight test, Rover has inferred Zuni extracted for enough to reach plane's horizontal tail surfaces, very necessary following them of stainless steel. Below, aircraft armed with Sidewinder and Zuni is parked with wings folded in carrier-stowage configuration.



Crusader, powered by Pratt & Whitney J57 P-20 engine producing 15,000 lb thrust, flew out for testing after flight with four 100-lb bombs mounted on multi-purpose pylons under each wing. Note that two-position wing has been used for cruise-type loading.



F8U-2NE in flight with 10 100-lb bombs on underwing pylons and eight Zuni rockets in drogue launcher. Other mission equipment during evaluation missions included four 20-mm cannons for aerial combat and low-level strafing zone.



Crusader took off from Vought's Great Point, Tex., facility carrying two 2,000-lb bombs, mounted on pylons under each wing.



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Glass Fiber Cockpit Section Used in C-141

New York—Glass fiber cockpit sections for Lockheed's C-141 transport aircraft are being used by Lockheed General Co. on development of the C-141 jet freighter. Use of mold instead of part-by-part buildup reduced development time for the section by 40%, Lockheed officials say.

Without the technique, development personnel would have had to await construction of the first production hull before beginning production installation of 1,200 electrical mess and 11 sets of wiring, taking control cables and crew facilities.

There were other design improvements. For JetStar development, then adopted for the C-141 when it proved to be a practical cost item and shortened overall scheduled completion dates.

Glass fiber section is obtained from full-scale plastic models of the flight deck hull. Time is saved since fibers can be trimmed to exact proportions, whereas metal must be filed in most instances, according to Lockheed.

Lockheed also speeds up formulation of air systems, which can be set along their edges and bent to the hull's contour, eliminating need for a variety of detailed fabrication tools.

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CONTINUAN HOY LAS CONVERSACIONES DE MIKOYAN

Cubans Display Wreckage of U-2

Cuban newspaper "Revolucion" prominently displayed photos of wreckage of U-2 high-altitude reconnaissance plane. Cuban reports stated that the aircraft, piloted by USAF Maj. Rudolf Anderson, Jr., was shot down by Cuban anti-aircraft batteries. Unofficial U.S. view was that the reconnaissance plane was hit by Soviet supplied anti-aircraft rockets (AM Nov. 12, p. 34). Body of the pilot was returned to the United States for burial. Captain in the newspaper said: "Wreckage of the North American U-2 plane shot down over Cuba while engaged in an espionage mission." U.S. observers have indicated that although Soviet equipment was used to shoot down the U-2, the actual firing was performed by Cuban troops, adding that U.S. sources believed Soviet technicians were under strict orders not to take action against U.S. aircraft. Lockheed-built plane was downed Oct. 22.

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NEW AEROSPACE PRODUCTS

Lightweight Cooling Fan

Cooling fan for electronic applications weighs 1.3 lb and delivers 230 cu ft of air per minute at free delivery.



Fan is 7 in. in diameter and 2 in. thick, making it suitable for embedding in any aircraft panel, the manufacturer says.

Fan has precision-ground stainless steel ball bearings, can be used continuously at any temperature from -50°C to +60°C. Fan operates at 3,580 rpm, angle-plane, 115 v., 50/60 cps., consumes 12 watts. Price is \$65 of a high-strength polycarbonate plastic.

Rotron Mfg., Woodstock, N.Y.



In-Line Shut-Off Valve

Valve CMV-355 series gives dependable control of liquid air or cryogenic propellants in the 1/2 in. line especially the manifolds system.

Valve may be plated from line feed being used or from a separate pressure source such as a vacuum or dry head. Valve is made of aluminum alloy and available with O-ring or diaphragm Testa seal. It can handle pressures up to 100 psig, the manifolds system. Standard models are 100 vdc and 25 vdc. Valve sizes available are 1 in., 1½ in. and 2 in. Models are also available for cryogenic service.

Mautz Valve Corp., Bonney, N.J.



Center of Gravity Locator

System measures imbalance in X-Y axis directly and allows location of an object's center of gravity to within ±0.001 in. on three axes.

System consists of a detecting head and a portable reading instrument placed in line-of-sight relation. Adjustable horizontal detection head has a defined measuring surface to which a variety of gage and holding devices can be adapted. Calibration of the system is accomplished by placing a known weight a known distance from the center of the head, marking a precisely known location.

Detecting heads are available in 250 lb, 1,000 lb, 2,500 lb, and 10,000 lb load carrying capacity with imbalance ranges of ±25, ±100, ±320, and ±1,000 lb, respectively.

Brown Corp., 50 Bent St., Newton, Mass.

Purification Pump

Aerospace pump (Model 4002) purifies gases dry air, free from oil and carbon at altitudes as high as 65,000 ft for pressurizing aerospace fuel and instruments.

Pump is a d.c. unit operating on 90 watts at 15 cps. Pump is guaranteed to have a 1,000 hr. life, the maximum pressure, and a circulation capacity of 975 cu. in. per sec.

Auto Devices Inc., 8225 Lancaster Blvd., N. Hollywood, Calif.

Wire Welder

Portable portable welder made in Mautz model 6010. Welder weighs 16 lbs, uses, thermocouples, fittings, etc.

Unit, called "Mawse," weighs 21 lb. Weld is made by a hand-held "shuttle" shaped like an eraser point, a ground it holds in holding the work points in place. From 4 to 32 sec is needed to accomplish the weld, depending on the thickness of the work. Spot-weld limit switch provides limit range for all types of metals.

U.S. Distributor, Price & Rotenbeck, P.O. Box 30, Hayward, Calif.

Ballistic Integration System

Solid-state tester (Model ST-100) obtains ballistic data from rocket motor static tests and integrates it immediately upon completion of tests of tests and more performance and efficiency.



System accepts four channels of input data simultaneously from three and pressure transducers which it processes electronically to produce a readout elimination of the integration of the three pressure transducers, pressure, vent time, and the integration of the static motor Readout is via printer and logic block, with provisions for digital magnetic tape, disk storage, and magnetic tape.

System is 45 in. wide, 23 in. deep and 77 in. high and weighs 850 lb.

B & F Instrument Co., 1644 N. Lawrence St., Philadelphia, Pa.

Gyrogenic Quality Meter

Panel meter gives continuous reading of quality gas from vapor by virtue of cryogenic fluid at a given point in a cryogenic fluid. Provisions also are arranged for operating a small chart recorder recording micrograph or oscillograph.

Quality meter gives readings over the full vapor range from 0 to 100% with ±1% accuracy across the full scale. Meter consists of a pipe section which is inserted into the cryogenic system and an electronic circuit that can be so easily located.

Applications include nozzle fuel analysis, booster fuel efficiency studies, pump cavitation studies, and starting effect studies.

Space Sciences Inst., 2 Motor Rd., Niskayuna, N.Y.



Electronic Thermometer

Electronic thermometer gives accurate readings of surface temperatures in 1 to 10 sec, the manufacturer says.

Unit consists of a probe and a component of an electronic circuit as well as point-to-point temperature conversion of heat detecting device. Thermometer allows designers to plot graphs of heat sinks and solar collector thermal measurement during development processes, thereby verifying calculations without refrigerating the field package, the manufacturer says.

Thermometer is available in 50-100F, 150-250F, -0.100C., and -180-200C ranges. Accuracy is ±3% of scale range. Unit is portable, housed in a wooden case and powered by a rechargeable battery.

Electroheat Research Corp., 108 S. Clark St., Clarendon, Calif.

Purging Unit for LOX Tanks

Mobile purging unit blows heated air through liquid oxygen tanks to cleanse them.



Unit passes atmospheric air through a filter and compresses it to 5 lb per cu. in. at a controlled flow. Drives are hydraulically heated to 200° F. air passes and then free air to liquid oxygen tanks in a loop length of least 10 ft. Tank insulation is the atmospheric type illustrated in use at 10 hp, but special sizes are available.

Spacelab Turbine Co., 486 New Park Ave., Hartford, Conn.

Spunge Gasket Material

Cloud-cell sponge gasket and seal material called Vito Spunge is said to give satisfactory performance in corrosive, hydrocarbons and high temperature environments unsatisfactory for synthetic rubber composed gaskets and seals, the manufacturer says.



Material resists deterioration of jet fuels, solvents, hydrocarbon solvents, hydrochloric acids, permanganic acid, bleaching alkali and potassium, and other chemicals and common solvents at temperatures of 400°F and above, according to the manufacturer.

Material is reported to be well suited to aircraft and missile applications as well as other fields.

The Connecticut Head Rubber Co., 607 East Street, New Haven 3, Conn.



Portable Microfilm Reader

Lightweight, compact reader for engineers needing reference to engineering drawings on microfilm occupies one sq. ft. of desk space and weighs 31 lb. in the microfilm reader.

Called Portable Aperture Card Reader, Model 3MKR, the device projects a 10x 16 in. by 12 in. image on a magnified screen. Reader has three 15 in. x 15 in. aperture card stage controls, a remote control switch, a power source consisting of a standard 110-volt outlet and a lens control knobs located at hand level. The aperture card is inserted between two planar flats, to prevent scratching and breakage.

Recordal, 770 Broadway, New York 3, N.Y.

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BUSINESS FLYING



CZECHOSLOVAKIAN'S L-40 META SOKOL, business plane at Brno with a supercharged 140 hp engine and features a seven-blade leading gear. Price of the airplane, delivered to the United Kingdom, is \$12,500 duty paid. Dash Coach Av 2 is background.

Aviation Week Pilot Report:

Meta Sokol Shows Ruggedness, Stability

By Herbert J. Coleman

BRAZ-Czechoslovakia's four-place Meta Sokol single-engine executive aircraft is a rugged, early flying plane especially designed for operation in rough conditions where maintenance could be a logistics problem.

Aircraft, which has been flown since 1956, has been fairly successful as a Czech export item, although government sales have been slow to gain popularity overseas. It is being phased out of state production here this year, probably due to overheads now being put on the front-engine Morava 2000 (AW Oct 29, p. 92).

Despite this official position, the Meta Sokol continues to fly with any of its Western counterparts, including price. Airplane's price, delivered in the United Kingdom, is \$12,500 duty paid, according to distributor Peter S. Clifford, Oxford Airport.

In line with Czech government policy, the single-seat Czech version of the aircraft can be used in countries Africa, Bulgaria, and in Czecho-Slovakia. Unique aircraft made leading gear was especially developed for the rough landing conditions found in relatively undeveloped areas.

Another sales factor in the Czech auto engine has been to maintain a high degree of stability, exemplified in the low-cut wingload and large safe loadings in the sliding canopy. High side trim was also added for more maneuverability and critical speeds.

Airplane flies by this AVIATION

Wing, pilot at Brno Sports Club field, a rough grass strip about 10 m. from the industrial city of Brno, was an Ostrava demonstrator with Czech registration OK-NNM. Pilot for the flight was Miloslav Kocour, of Ostrava, the state's export organization.

Value of the no-case motorcycle gear is considerably apparent, cockpit sits level on the main and two cushioned seats provide good support. Seats are well padded, even the front ones, though the pilot is barely seated at Brno.

Interior of the Meta Sokol is well appointed and there is considerable leg room in both pilots' positions and in the rear seat. Luggage is stored behind the rear seat.

Weather for the first flight was poor, with ground fog patches and cloud of about 200 ft. Flight was abandoned after about 10 min. of looking for a hole in the clouds. Weather conditions later improved to a 6/10ths cell.

Rolls Engines for Morava

Ostrava the Czechoslovak state export organization, has shown considerable interest in fitting the Morris 2000 executive twin with Rolls-Royce Continental engine to replace the present 140 hp M-17 engine (AW Oct 25, p. 92). Primary reason is to increase Morava export sales to the West, because low net cost/basis resistance because of the question of 14,000 speed and part availability.

eng. of 1,000 ft. Wind was 15 kt. from 270 deg. and ground temperature of 53°F.

Starting the M-352 140 hp engine is simple and consists simply of turning on center and ignition switch, adding a few strokes on the primer pump, and pushing the starting button. Starter charge is left as far as use and takeoff, engine is warmed up at the usual 3,000 rpm.

Overall feature of the Meta Sokol is a button on the control wheel, resembling a radio button, which controls the rate of the two-blade Avco V-410 metal propeller. For takeoff, button is depressed as throttle is opened, until prop is running at 2,700 rpm.

Takes off is made at this power setting, with 20 deg. of pitch extended. The airplane has a tendency to yaw to starboard on takeoff, but this is easily controlled by rudder action. Roll was slow, even in the rough-ground conditions and climb was about 15-20 mph., rising to 30 ft./sec. and 2,000 ft. with maximum rate of climb. Landing gear doors were able to open and to large hand lever between the pilot's seat. Supercharger was cut off at 2,000 ft. when power was reduced for cruising at about 130 mph., normal speed for the airplane.

Meta Sokol is responsive to hand handling and has a tendency to hold its position when it is out established. Little trimming is needed, even in sharp turns at 30-40 deg. The Meta Sokol is restricted to aerobatics, the airframe is stressed to 5.50 with defo-

FUEL CONTROL

The de Havilland aircraft fuel control is said to be second to the German engine automatically controls carburetor and fuel system to eliminate waste of power demands. It features automatic temperature-controlled starting and automatically cuts back fuel pre-selected or required.



AIR CONDITIONING

de Havilland design and manufacture completed an airconditioning system for the aircraft. The system is self-contained and can handle temperatures from -40° to +40°C. Components can be supplied to meet individual requirements.



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A range of three generators are most prominent of de Havilland's has been designed and approved and are being supplied to both civil and military aircraft. Power outputs both single and duplicate range from 100 VA to 2500 VA.



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Rapid, accurate testing and fault location are obtained by means of the de Havilland electronic test equipment. The de Havilland electronic test equipment has been developed and adapted to meet the needs of the aircraft and can perform up to 1,000 tests per hour on an inventory of 600 air circuit breaker, thus leading to greater monitoring, reliability and safety.



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Source: Federal Aviation Admin.

initial positive acceleration. Never exceed speed (V₁) at 162 ft. Between model aircraft operating speed is the limit 125-130 ft.

Even in good weather, such as encountered during the flight, Meto Solok control forces are small and little elevator deflection is needed to keep the control.

Minor lateral oscillations tend to dampen quickly.

However, in still conditions the warning is fairly light. In a ground, full-stop stall, with power back to idle, the warning is a tail buffet that is heard, rather than felt, and only wing drops off slightly at about 87 ft. Recovery is fast by oppositeudder deflection and by dropping the nose to regain flying speed.

In a power-on climb stall, at 2,000 rpm, the Meto Solok stalls out at 57 ft with much the same reaction.

Stability Trimmed

Airliner has excellent climb characteristics, obtaining about 800 fpm with propeller operating at 2,000 RPM. Sopwithian stability is even for this maneuver. In a circular turnabout, with power not back, the Meto Solok can be set in position, say a 15-degree bank to the left, and it will continue the maneuver under hands-off conditions, as a demonstration of its inherent stability.

At a maximum continuous power rate, using 30 ft/lb Hg and 2,000 rpm, the Meto Solok reaches about 134 mph indicated speed. Run is quite short, due to high-lift conditions before the engine cuts.

Three-Point Touchdown

For landing, the gear and all control flap wings are extended at about 75 ft, or about 100 ft above the surface of earth, holding an altitude of about 70 ft. At 18 ft, just three feet and the Meto Solok was down on a fairly flat glade. Touchdown was then gentle. To bring the aircraft off the road, third-wheel located about midway between the two main landing gear, which were then up to about 20 ft, holding roll was short and there was no problem in directional control. The airplane could be turned on its own axis, another strong point in favor of its use in undecelerated turns.

Angular, slow, GVNMD, was limited to operations in temperatures ranging from -20°C to +40°C. Beyond the limit, the engine is required to accelerate an off-engine, usually performed before the airplane is transported to Africa or South America.

Regime is an air cooled, in-line four cylinder powerplant fitted with a single variable centrifugal supercharger and a low pressure fuel injection system,

located forward of the tail posts. Fan is carried in two leading edge tanks, both vented, and in two top tanks which now are standard equipment on the aircraft.

Wings are of cantilever construction with a 6.1% camber at the outer sections, elliptical tailplane is mounted on the third wheel. Wing area is 158 sq. ft and chord is 6 ft 3 in at root, tapering to 3 ft 3 in at wingtip. Aspect ratio is 7.69 and the gross weight is 2,100 lb.

Meto Solok is built in four main sections: fuselage, rear fuselage, main wings and tail. Main wings are truss type. Forward fuselage is all-skin monocoque construction and is bolted together with the wing sections. Rear fuselage is a case made without using extra struts and with one frame at midlength.

Overall air mass movement around the airplane is about 7 kg. Range is about 700 m.

Trainer Master

In a short flight in the Z-326 Trainer Master, speed and sensible training plane, highly structured cockpit includes an off-control stick for instrument control flight. The "Tutor" is used extensively in Soviet pilot training, particularly in Soviet flight academies. As the initial trainer for cadets in Czechoslovakia, for instance, Cuban pilot trainees are checked out on the Trainer



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PROBLEMATICAL RECREATIONS 145



Find the similar integer which is such that if the digit on the extreme left is transferred to the extreme right, the new number is three and a half times the original number.

—Contributed

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LATEST VERSION of the Centrifugation Trainer Master, fully retractable tail and gear plane, is the Z-315, which has servoreversible landing gear. Wing has been stretched one foot over previous models of the aircraft. Gase pressure below wing slightly to take up report slack or result of a gear up-loading. Trainer Master is certified aerobatic with tip tanks installed but empty.

Motor lecture moving to more sophisticated aircraft such as McGinnis light

Kitsch and the airplane can be equipped with skin for moisture work and has proved quite popular in Central countries as a glider tag. It is built in the Minnow Aircraft Factory at Orléansville and has averaged very high marks in first flight on 1957. First engine was a 100-hp Continental, landing gear and a headgear built or obtained in excess of the weight of the Trainer Master's aerobatic capabilities. Wingspan also has been redesigned to take tip tanks if customer desires, and way on the Zondal has been so loaded we best.

Takoff from Bens sport field was short, less than 1,000 ft, and Trainer Master was airborne at about 92 mph. Climb to 2,000 ft was accomplished at about 70 mph and airspeed held up to 125 mph, the normal operating speed.

There appears to be no limit to aerial uses of the Trainer Master. On the flight, maneuvers included tight loops, a tailing tail, and chandelle. Levelled flight listing 11 were not also made, with no engine current experienced. Curiously, has been fitted with a check valve and booster in fuel tank flowing during flights in this position.

Landing will also run quite short and

shifted, but the turns must be empty. Base landing is of welded frame construction, covered with metal skins; there is some use of wooden struts for reinforcement. Wing is a semi-monocoque tapered utilizing one main and two auxiliary spars. Main torsion arms are interconnected to a torsion bar formed by the main spar and lead edge stiffener. Tailplane is all metal with fixed rudder trim tab.

SCIENTISTS AND ENGINEERS

AC Spark Plug, the Electronics Division of General Motors, Research and Development Laboratories in El Segundo, Calif., is looking for scientists and engineers especially of interdisciplinary R&D work in the following areas:

Applied Mathematics: M.S. or Ph.D. in Applied Mathematics or Physics with strong background in one or more of the following areas: Nonlinear Differential Equations; Theory and Application in Control Mechanics; Theory of Two-Point Boundary Value Problems; Optimization Theory; Dynamic Programming.

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Meta Sokol L-40	
Length	24 ft. 9 in.
Height	8 ft. 2 in.
Wingspan	10 ft. 9 in.
Wing area	156 sq. ft.
Gross weight	2,800 lbs.
Empty weight	1,787 lbs.
Payload	515 lbs.



Said Svante Arrhenius: "The change of the logarithm of a chemical reaction rate covariant with respect to temperature, is inversely proportional to the square of the absolute temperature."

The aerospace industry is searching constantly for strong, light-weight, heat-resistant materials. Multi-layer glass fiber, bonded with a plastic binder, is beginning to exhibit superior properties. Until recently the glass fiber has been far more heat-resistant than any fiber.

Scientists at Lockheed Missiles and Space Company, however, have developed a compatible binder. This now makes it necessary for the glass-producing industry to make a glass to match its superior heat-resistance.

Comparable advances are being achieved in dozens of disciplines in which Lockheed is engaged. As Systems Manager for the AGENA Satellite series and the POLARS FFM, Lockheed probes all areas of aerospace endeavor.

Lockheed Missiles & Space Company is located on the beautiful San Fernando Peninsula, in Sun Valley and Pico Alto, California. Why not investigate future possibilities at Lockheed? Write Research and Development Staff, Dept. M-32A, 581 North Melrose Avenue, Sun Valley, California. An Equal Opportunity Employer.

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WHO'S WHERE

(Continued from page 21)

Changes

Stephen E. Haig, director of marketing, Defense Products Division, Fairchild Camera and Instrument Corp., joined N.Y. on Oct. 1.

Frank Grimes, vice president, Eastern Systems Division, The Comsat Corp., Bellmore, N.J.

François B. Miller, production control supervisor, Sudlow, Inc., Las Vegas, Calif.

Ron E. Williams, production manager of data systems, Computer and Control Div., Division 1, Loral Systems Inc., Woodland Hills, Calif.

William R. Stevens, director of construction at Skycorp Air Canada's newly announced orbital station at Ward's Island, Quebec, Canada.

John T. Williams, manager of internal

Telephone and Telephone Corp., a unit

of the Bell Telephone System, Inc., for Project MIL, the new

VSAT system.

Robert E. Goldsmith has been appointed to the engineering, R&D, and Research Div. of Philips Corp., Philadelphia. He succeeds Dr. Donald C. Goss, Vice President for Research.

James T. Morrissey, manager of Ward's Island, Quebec, Canada.

George Alexander, manager of United Technology Corp.'s newly established technical liaison office, Houston, Tex.

Joseph B. Kishner, assistant general manager of the Space and Communications Division, Hughes Aircraft Co., Culver City, Calif.

Dr. Malcolm R. Carter, Dr. George F. Smith and Dr. Lester J. Ivan have been named to honorary distinctions in making Hughes Research Laboratories' Malibu, Calif., Dr. Louis C. Van Allen, former director of the International Space Science Institute, and Dr. John D. Kraus, now chief scientific consultant

reporting to the van president and general manager of Stephen Aircraft Co.

Dr. Russell A. Lippman, director of photo Defense Research Corp., St. Louis, Mo.

Bob F. Holzman, chief of the recently established Communications Division, McDonnell Douglas Astronautics Co., St. Louis, Mo.

Donald B. Adler, head, Magnetic Devices Division, Comsat Elec. Co., Los Angeles.

Walter F. Stevens, director for construction at Skycorp Air Canada's newly announced orbital station at Ward's Island, Quebec, Canada.

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Charles M. Schreiber, Jr., senior project engineer and program manager of the GE USA Space and Communications Division, a division of General Electric Corp., Schenectady, N.Y.

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Robert E. Feldman, department manager of the newly established Thermosystems and Chemistry Department, Electronics and Components Division of Eastern Electric Manufacturing Co., St. Louis, Mo.

Donald B. Adler, head, Magnetic Devices Division, Comsat Elec. Co., Los Angeles.

Walter F. Stevens, director for construction at Skycorp Air Canada's newly

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engineer and program manager of the GE USA Space and Communications Division, a division of General Electric Corp., Schenectady, N.Y.

Thomas J. Schaefer, first director in research and development, Dick A. Lindquist & Associates, Inc., Chicago, Ill.

D. L. E. Gulyas, manager materials research, Tronox Division of Borden, Inc., Newark, Calif.

J. Kenneth Rapp, staff consultant, Gen. Ed. Kosher Inc., Whittier, Calif.

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STRUCTURAL DESIGNER Background in aircraft structures as related to the field of control systems with a knowledge of heat transfer and design load factors.

STRUCTURAL DESIGNER Background in mechanical design, analysis of structures, mechanical components, forgings, and capsule of performing preliminary stress analysis.

ELECTRICAL MECHANICAL DESIGNER Design development, and redesign of navigation, communications, electro-hydraulic, and electro-mechanical systems. Must have a minimum of 3-5 years in circuitry, component selection, and testing of these systems.

STRUCTURE TEST INSTRUMENTATION DESIGNER Preparation and coordination of test programs including analysis of flight test data.

STRUCTURE TEST INSTRUMENTATION DESIGNER Design, build, and evaluate flight test instrumentation. Magnetic tape, data analysis and telemeasuring experience required.

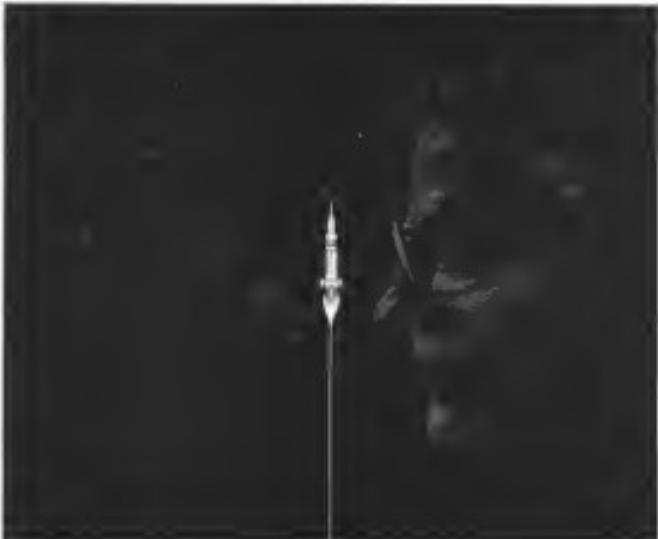
AEROMECHANICS DESIGNER Finite, Plan wind tunnel tests and data analysis. Stress measured analysis of advanced ratio aerodynamics performance designs. Fixed or rotary wing exposure to perturbance analysis, including coordination of flight test programs.

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AVIATION WEEK AND SPACE TECHNOLOGY, November 19, 1962



Two major task areas are of
space interest:

ADVANCE ENGINEERING

This branch analyzes existing or proposed space system designs and operational characteristics to establish system requirements and feasibility involving design concepts. It includes three subareas:

Aerodynamics—concerned with dynamics and trajectory analyses; aerodynamic heating, reentry studies, aerodynamics, and flight mechanics.

Preliminary Design—evaluates configuration feasibility to meet analysis changes and future requirements as dictated by program requirements.

Future Systems Analysis—studies advanced systems with combination of tradeoffs between various parameters as well as projected development of new and higher performance hardware.

PRODUCT IMPROVEMENT

These programs provide for improvement the major developed the structural, mechanical, and materials disciplines including aircraft, missiles, structures, and thermal. Tests also are carried in the areas of electrical systems, instrumentation, and automotive checklist. Computer product improvement of tests will be performed to support design, development and program evaluations required in the evaluation and test programs.

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analytical ENGINEERS

Within the broad domain of energy conversion at Pratt & Whitney Aircraft, particular attention is being devoted to the demanding requirements of highly advanced aerospace power and propulsion systems. From diminutive microsystems to the problems of aircraft "lift-off" and "take-off" as exacerbated by the demands of tomorrow's technology.

For example, our advanced aerospace systems span the spectrum from 1000WDC and 400WAC continuous to hypersonic propulsion. The aircraft required regen-heat-exchangers for maximum power for hypersonic Mach Number levels. To satisfy severe requirements for the unique problems encountered, consider an example of the need for a power system which must operate at temperatures up to 1000°-1400°F. Our unique enhanced propulsion criteria calls for power systems five to three times lighter in weight than those existing today.

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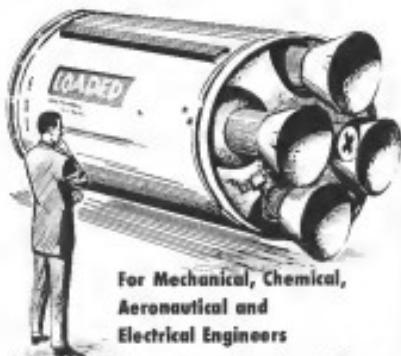
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LETTERS

Reversing Parkinson

I believe Astromax West makes the point you Nov. 5 article (p. 26) has letters with much heads and who are familiar with Parkinson's law will be interested to know that our goal is not just to give the CTC and G-1/P a headache, but also to demonstrate by some means. We can't do it alone. The longer I live in all of its accumulated impacts and reverse these overall costs (one of the world's best and most consolidated systems of reduced aerial needs), the less time still successful large audiences of us necessary to do it. We have to make more personal, deducible, down-the-line, thought-down arrows and enough other thought fed focuses as the primary sites of the art to produce success! This will clearly continue the business in the area of completely revolutionizing the way we do business. We are now the total short and medium range cargo aircraft at a Stevens cost that will make a household American airline controller smile. Thank you for your coverage of our present p. G-1/HB program to give us this additional credibility. The right people, quickly and easily. Please, if you are at the Atlanta Airport, Long Beach Calif., when we have been operating for the past six months in new facilities under this at our local Gemini offices as recorded in your (best) article.

F. W. STEWART
President
Stewart Davis, Inc.

Instrument Crusade

After reading the "Slow Recovery" letter by Max Rodwin is your Oct. 6 issue (p. 126), I feel compelled to comment on certain of his observations and conclusions in an effort to set the record straight. Max states that "the TWA 7300 at Kennedy was the result of instrument errors, not crew errors or reactors." I would agree with him since, it is a pity, however, that the responsible regulatory agency of the airline industry did not act after this tragic accident. However, a more recent example occurred in a much smaller aircraft in the same year. In 1979, PIAA urged the meteorology authority of aviation industries and powered test engineers whose plagued low density giving jet engine turbine wheels had gone toward the aerofoil. Our proposal fell on deaf ears.

Now, however, in an effort of the preceding, the CAB recommends cancellation of such proposal.

Max Rodwin goes on to say that it is understandable that some of the crew did not notice the impending failure of all 41 engines. I note that the concern expressed by the investigators was regarding a malfunction of 7-10, with increasing emphasis subsequent to failure. Additionally, he states that "The flight engineer acts with severely limited knowledge" (as far as 707 equipment, should certainly have been able to monitor the relatively simple to test, and limited number of checks re-

quired to notice a catastrophic air flow failure."

Having reported 7,000 hr in the air and approximately 1,300 hr in an F/A as a flight engineer from my experience I can honestly say that it is quite possible that whatever indications they made could easily have indicated they could easily have generated in the crew and especially by the flight engineer.

Rodway Sky Radar has never been exposed to the shocking instrumentation errors and layout incorporated in our jet aircraft. We have not had to do so. For all benefit, it would like to assure the situation which exists. The majority of cockpit instruments are located between the pilot and copilot in the forward instrument panel. The flight engineer is located in the rear seat for the first flight of the F/A, FCT, N-1 and N-2, and the second flight of the F/A, N-1 and N-2. The flight engineer's seat is located in the rear of the aircraft. The flight engineer must have been trying to assist somebody's confusion prior to further disengaging.

He did recall in saying, the "clouds" were two sets power type display. Under such circumstances, I am curious to know if the flight engineer would have considered the use of altitude scales. The balance of the engine parameters—power, pressure, quantity and quantity—are located on the extreme right side of the flight engineer's panel. Therefore, to determine the most critical information, one need only compare the engine parameters with those displayed on the cockpit panel. The flight engineer's panel would be located approximately 4' 10" off the floor. He could see dual displays without completely opening the other. Think. Get a few in the industry here, finally come to their senses as displayed in the cockpit layout of the F/A. There is no reason to have the flight engineer's panel in the cockpit, but open our eyes; have follow up and ears.

Since 1978 the PIAA has continually opposed the present jet engine serial mismatch system as being unacceptable. Therefore, the PIAA has proposed a maximum of four sequential aircraft in a row for argument which have been presented to the FAA, CAB, airlines and manufacturers but open our plenleys have fallen on deaf ears.

Max Rodwin is of the opinion that the main cause of the crash was due to the shortcomings and stated "...that things have to be accomplished quickly in as even a more professional manner than took on the project."

Once again I tend to agree with him, nevertheless, the PIAA has proposed a maximum of four sequential aircraft in a row for argument to the following cockpit design philosophy and concept that have been followed in our jet aircraft.

The point again stated may not be in need to be raised as the subject. I do and will continue to do, for there is a definite need to realize that a becoming extremely important.

This article of mine, which includes the PIAA is one of "those me the bodies and I will eat, until then don't bother me, I have this weak sick to do."

George B. Hyman
Vice President Engineering PIAA
Brooklyn, NY, U.S.A.

Candid Camera Caper

I write this letter sans eloquence, as I feel that further mention of this amateur subject only adds fuel to the fire. However, according to Astromax, White has agreed to acknowledge the source of the House Governmental Document. I would like to point out that amateur camera series of terms radio call flight engineers (AVG Sept. 24, p. 8; Oct. 5, pp. 42, 43), then I find it interesting and proper that other flight engineers present the other side of the coin. We are told of the crew, but not the engineer with the first name and second name, or even worse, their names of themselves flying on public info, etc., do we? Is this the latest qualification that the news media is taking sense to feel the public wants?

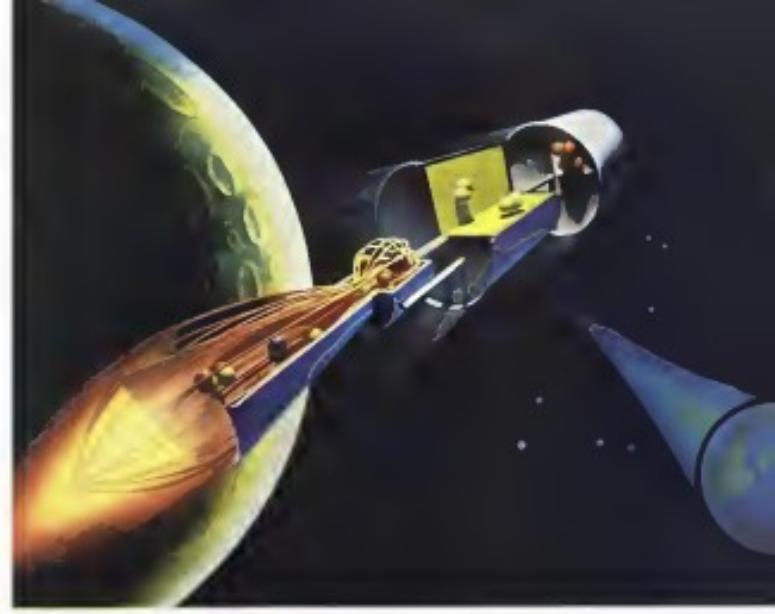
This letter is addressed to the readers of *Astromax*. White, I hope you will have a workable solution of what happened behind the closed cockpit door.

If one looks in the people who transport us around in commercial aircraft, he can't help but be disturbed that Phyllis Siegelman let herself in my cabin the night before the flight. She was a new unknown passenger while she was left in before that little old man was actually flying. Then you can be assured by the very publications you read that she was being lied to believe that a senior citizen, a widow, who had been to church, is a terrorist. Come on, not at this age.

It would not be fitting to discuss the name of a regulation that prohibits even amateur film making while in the active pursuit of their craft, or one that照片 and television persons shall be of the age of 18 years or older, and shall not be under 18 years. There are anomalies that exist that do, in fact, violate the strict letter of the law, while at the same time offering greatly to the spirit of the law. To believe otherwise is rather naive. That person who is flying these aircraft, and who is going to be in charge of decisions of duty to the post of pilot in the event that they are suspended is immature.

I am forced to make a letter supporting the commercial pilot and amateur hobbyist. I am not sure if it is possible to have a professional flight engineer, to do this function as for the professional pilot. If this attack were upon the Air Force Pilot Association, it would be in front of me. I would support it. The fact that ALPA has apparently responded in finding an unreasoned attitude does not mean that the flight engineer might prove effective. However, this model attempt to disclose pilots with a slightly meaningless fact that in basic is inverted and simplified for ease of propagation to its obvious need in regards safety, as no need to stand by and watch computer monitors, and the like. The real problem is the absence of the ability of pilots of commercial aircraft today, I stand behind them 100% when my attempt is made to underline the confidence and respect due them for their responsible and highly professional performance in the carrying out of their duties.

As a Wisconsin-based flight engineer for American World Airways Frankfurt AM Main, Germany



THE TAMING OF THE HYPERGOLIC SHREW

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